DOCUMENT RESUME

ED 209 078 SE 035 773

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TITLE Improving Cognition: A Multi-Cultural Approach. Final Report, MICA Project: Multi-Cultural Improvement of Cognitive Abilities.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Feb 81
GRANT NIE-G-78-0158
NOTE 239p.; Contains occasional marginal legibility.

EDRS PRICE MF01/PC10 Plus Postage.
DESCRIPTORS Academic Achievement; *Bilingual Education; Cognitive Development; Curriculum Design; Educational Research; Elementary Education; *Elementary School Mathematics; *Elementary School Science; Instructional Materials; Mathematics Education; Mathematics Instruction; *Minority Group Children; Pilot Projects; *Program Descriptions; Science Education; Science Instruction; *Second Language Learning; Teaching Methods
IDENTIFIERS Mathematics Education Research; *Multicultural Improvement of Cognitive Abilities

ABSTRACT

Described and summarized are the results of a program designed to improve the intellectual, academic, and linguistic functioning of children in a linguistically and culturally mixed setting. The program, Multicultural Improvement of Cognitive Abilities (MICA), was installed and supported by project staff in nine participating classrooms under two experimental conditions, intensive and economical, with the difference being in the extent to which they were supported by project staff. The activities were provided to all participating classrooms in addition to an ongoing bilingual program. Pupils had the opportunity to engage in approximately 100 mathematics/science activities and experiments. Each activity was self-contained and required pupils to complete worksheets using basic mathematics and literacy skills. A high degree of verbal interaction and cooperation was necessitated by the activities. The results were highly encouraging in revealing consistent positive gains that can be more or less attributed to participation in the MICA program. Attachments give details of the program as well as rationale and are appended to the document. (MP)

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"Improving Cognition: A Multi-Cultural Approach"

Final Report

MICA Project:
Multi-Cultural Improvement of Cognitive Abilities

National Institute of Education Grant No. NIE-G-78-0158

by

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February, 1981

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ABSTRACT

This report describes and summarizes the results of a program designed to improve the intellectual, academic, and linguistic functioning of children in a linguistically and culturally mixed setting. The program, Multicultural Improvement of Cognitive Abilities (MICA), was installed and supported by project staff in nine participating classrooms under two experimental conditions, intensive and economical, with the difference being in the extent to which they were supported by project staff. The program activities, taken from FO/D, were provided to all participating classrooms in addition to an ongoing bilingual program. Children were presented with the opportunity to engage in approximately 100 math/science activities and experiments. Each activity was self-contained, and, in most cases, required students to follow written instructions and to complete worksheets requiring basic mathematic and literacy skills. Program participants engaged in activities individually or in small groups which necessitated a high degree of cooperation and verbal interaction, both with the teacher/aide as well as with peers. Program effects were measured by tests of (1) Academic achievement in basic skill areas (CTBS), (2) Oral linguistic proficiency in Spanish and English (LAS), (3) Intellectual development across Piagetian based tasks (CCS), and (4) Program content assessed in both structured and non-structured settings (MINI & MINI-III).

The above analyses were based on 253 students in grades 3 and 4 who participated in the program for approximately 10/12 weeks. Children engaged in the math/science activities for approximately 1/2 to 1 hour per day, in addition to their basic course of study. Program effects were examined in a variety of ways which focused on treatment or condition by: school, sex, and age variations.

In the first series of analyses, program effects were examined by time, condition, school, sex, and age across each set of dependent variables separately. Thus, in the first series of analyses, consistent pre/post test score gains were found for all important measures. To some extent, gains interacted with treatment or condition, and school variations. Condition was significantly related to program impact on five of the eight outcome measures.

School by school variations were statistically significant in five of the seven analyses conducted. At this point, it is important to note that, to a large extent, school and conditions were covariate since condition was defined on a school by school basis. Results show that there were, nevertheless, significant variations between schools even with the same conditions.

Examination of sex differences resulted in negligible differences. There were virtually no meaningful differences between boys and girls as to either differences in base rates or program impact. In the two cases where differences were found (CCS & math achievement), comparison of the absolute differences revealed the differences to be psychologically meaningless.

In addition to examination by time, condition, school, and sex, age differences were examined. The total population was divided into four age groups. In this particular set of analyses, data were then analysed by an age group rather than by grade in order to minimize the effects of "overaged" children, a problem which is characteristic of language minority research.

Age group comparisons revealed age to be highly significant across virtually all of the outcome measures. A more detailed examination of the cell means suggested that the significant age effects were due to the oldest of the four age groups. Comparisons of pre and post cell means for each of the four groups showed the program to have been least effective for group four. Moreover, examination of language data suggested that this group tended to be made up of primarily monolingual Spanish speaking students. While this group constituted only about 7 per cent of the total MICA population, the data do suggest the need for further examination of the interaction between age and language characteristics. In this connection, it would be important to bear in mind that not all of the Spanish monolingual students were overaged or in the oldest age group. Moreover, even this group had shown substantial positive growth on both CTBS math and CCS measures. Why similiar results were not found across the measures remains a question. However, since language issues were not the primary concern of this report, answers to these types of questions will have to await more fine grained analyses.

In the second phase of the analysis, the performance of participating MICA students was compared to test norms and to several post hoc comparison groups. For a variety of reasons, this phase of the overall analysis of data was restricted to CTBS scores as direct controls across all of the outcome measures were unavailable. In the first set of analyses, two-way ANOVA results across MICA and comparison students resulted in significant main effects which were ultimately attributed to slightly larger gains for MICA students on third grade concepts and applications CTBS sub-tests. Unfortunately, data for these two sub-tests were not available for fourth grade comparison students. However, since most of the students participating in the MICA program were third graders (i.e., approximately 85 per cent), the results can be considered as indicative of the population as a whole. In all other comparisons, students participating in a bilingual program and MICA students showed consistent, significant, similiar gains in reading and math scores.

In a second set of comparisons, expected gains in academic content areas (i.e., reading and math) were calculated by obtaining the difference between norm raw scores equivalent to the 50th percentile for fall and spring test administrations. Fall and spring norm gains were then treated as "expected gain scores", and compared with pre/post gain scores obtained by MICA and comparison group students.

Results of this analysis revealed that actual gains did not always match or exceed expected gains for both MICA and comparison students.

In a few instances, control students fell slightly behind the norms. Moreover, when control and MICA gain scores were compared, MICA students out-performed controls in a significant number of cases.

In the above series of analyses, comparisons between control and MICA students were made on an aggregated basis. In other words, it could be said that both MICA and controls showed improvement on the average. This finding was not, however, to be taken to mean that all students in both groups improved or gained on the norm. In an attempt to determine the extent of improvement, a third series of analyses were conducted in which the percentage of students gaining on the norm was calculated for each group and then compared to controls. Results of this analysis showed that with the exception of a small difference in reading comprehension, the percentage of students gaining on the norm was consistently greater for the MICA group. Consideration of these results should bear in mind that this analysis concerns the percentage of students who gained at least as much as would be expected by a comparison to fall/spring norms and not to whether or not students gained in an absolute sense.

An attempt was made to determine whether or not the MICA children who did not improve (i.e., gain on the norm) constituted a specific sub-group of the total MICA population. During the pre-test period, before the program began, teachers were asked to identify sex to eight students who they felt were most likely to experience difficulty in mastering the basic curriculum or the math/science concepts. By this procedure, a group of "problem" students for whom the teachers had lower expectations than for their respective classes taken on a whole was defined. Comparisons between the "problem" group, and the remaining MICA group on both pre and post-tests showed the "problem" group to be consistently lower than the total MICA group. This is as would be expected. However, the absolute gain scores obtained by both "problem" and remaining MICA groups were virtually identical. In other words, even though the "problem" group scored lower on both pre and post-tests, their rate of improvement (i.e., absolute gain) was the same. Apparently, teacher expectation defined in this rather loose manner did not influence improvement in a direct sense.

The third phase of analysis was both confirmatory and exploratory in an attempt to further check the above results and to provide preliminary information for possible future investigations. A number of issues were examined through the use of correlational results. Consideration of these data lead to a further examination of the effects of the MICA program on the linguistic make-up of the MICA student population.

In a final series of analyses, correlational results were examined. The results revealed a high degree of stability in the relationships between the different tests which held across both pre and post-test administrations. Of particular interest was the relationship between linguistic and other variables assessed by the test battery. This led to an attempt to examine the extent to which improvement in oral language proficiency was consistent across subjects and languages. It was found that there were consistent shifts in a positive direction for both English and Spanish oral proficiency. These positive shifts were supported by a reduction of the number of children who in the pre-test were found to be of either minimal or limited proficiency in both languages. Unfortunately, this last series of analyses were not examined in terms of statistical significance due to a lack of appropriate controls. Results, nevertheless, did show a positive shift in the linguistic make-up of the total population.

The above results, on a whole, seem to be highly encouraging as they reveal consistent positive gains which can be more or less attributed to experience in the MICA program. For a number of reasons, however, these should be accepted somewhat guardedly. In the following closing section of this report, it would seem reasonable to review and briefly discuss a number of limitations in the study. It would also, in closing, seem reasonable to briefly discuss a number of direct implications as well as a number of analyses which could be considered in the future. Although the results of the analyses of program impact on the linguistic make-up of the MICA population was limited by a lack of control or comparison subjects, they did tend to suggest a generally positive shift toward proficiency in either one language (particularly English) or the other, and to some extent, proficient bilingualism. The total number of children defined as either "limited" or "minimally" proficent tended to decrease. On the other hand, the total number of students identified as proficient English speakers, proficient bilinguals, and partial bilinguals proficient in one of the two languages increased. Finally, the total number of monolingual Spanish speakers remained relatively unchanged. This latter finding is in contrast to previous research on the effects of bilingual programs which suggest a drop in Spanish proficiency over time (Saville-Trokie, 1973).

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Introduction

Despite a history of arguments from Aristotle to Dewey, one finds little evidence of teaching in the schools which is aimed at developing cognitive processes or thinking skills. Nowhere is this lack more evident than in compensatory education programs, particularly those designed for the nation's approximately five million language minority students. Far more frequent are curricula based on Thorndike's (1924) notions of "specific learning and transfer." Thus, one finds programs directed at the remediation of basic skills and English language deficiencies at the expense of thinking skills in the more general sense.

The problem, however, is not endemic to language minority or compensatory programs. In fact, in a study conducted by the National Assessment of Educated Progress (NAEP) based on a sample of 71,000 children, it was found that from 1973 to 1978 students showed measurable drops in each of the cognitive processes assessed. At each age, there were fewer students who could deal with simple problem solving tasks requiring the most rudimentary of thinking skills. One researcher (Moser, 1979) has gone so far as to suggest that instructional programs aimed at remediating basic skills tend to foster a dependence on rote formulas to solve any and all problems. The net effect of these programs, Moser (1979) argues, may well be to disrupt naturally evolving problem-solving abilities. In a longitudinal study of the 150 children receiving instruction in public and parochial schools, Moser observes that "prior to receiving formal instruction in computational mathematics, children show

a remarkable ability to solve problems through means of their own...using fingers, mental counting, manipulating objects. They are able to take on individual problems, apply analytic ability to determine the structure of the problem, and choose a strategy that matches the nature and structure of the problem. By the time students are older, they tend not to be as analytic, depending instead on predetermined algorithms and formulas." When these fail, the older students tend to give up and are left with the frustration of failing.

A recent review of the content of bilingual programs would tend to suggest an even greater emphasis on programs tending to foster a dependence on predetermined approaches to problem solving than is found in the regular classroom. In a recent review of curricula used in bilingual programs, Nieves-Squires (1980) finds that programs tend to focus on cultural/historical subjects and on English as a second language instruction. Basic skills are emphasized in the "content of the bilingual child's relative ability to learn them depending on language of instruction." While one finds little discussion in the literature on the topic of social studies and multiculturalism, there is virtually no discussion on the development of programs and curricula aimed at developing the cognitive, thinking, and problem solving skills. Even though there have been bilingual science curricula, they tend to be translations based on mainstream programs which assume basic skill development. As such, most have not been tested in bilingual settings.

The purpose of this report is to review a bilingual math/science program designed to facilitate intellectual, academic, and linguistic development. The following report will summarize the results of a study conducted over a 10 week period in which children in nine classrooms participated in an experienced based math/science program. The report will be presented in three major sections. The first section will provide a brief review of some of the recent issues which affect the development of thinking skills in bilingual and regular classrooms. This will be followed by a review of some of the basic principles used to formulate the math/science program used in the Multicultural Improvement of Cognitive Abilities (MICA) project.[1] The second section will describe the design and results of the study. In the third and final section an attempt will be made to summarize the basic findings of the study, point out its limitations and provide suggestions for further analyses of the data.

Overview

Researchers who have examined the cognitive tasks of conventional schooling find that schoolrooms tap a limited range of cognitive skills. Taba (1966), Borg (1970) find that teachers emphasize knowledge of specifics over interpretation, application, or analysis. Hudgins & Ahlbrand (1967), and Medley et al. (1966) find that more classroom exchanges

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[1]Originally funded under the title: "Improving Cognitive Abilities: A Multi-Cultural Approach."

are convergent rather than divergent in thinking style, relying on memory rather than evaluative thinking. Findings such as these illuminate the process by which the possible cognitive advantages of bilingual/bicultural students may become lost in the classroom (Duncan and De Avila, 1979). A picture of a typical classroom arises which emphasizes rather simple tasks such as symbol recognition or rule recitation (knowledge or comprehension related as opposed to synthesis or evaluation related), centering on concrete experiences. Teachers' classroom behavior, it would seem, stresses exactly that mode of cognition for which bilingual/bicultural children may be the least prepared--convergent thinking. Moreover, it seems to be carried out in a fashion which does not allow for individual differences (Ramirez and Casteñeda, 1974).

Not only does the content of conventional classrooms appear to be convergent, but also the methods of instruction seem to leave very little room for student initiation, placing a great emphasis on conformity to teachers' expectations. While Cohen et al. (1976) did not find the kind of lock-step classroom organization Adams and Biddle (1970) cite--where one teacher lectures to a class of students a majority of the time--they did find that when individualization on the basis of student interests occurred, it focused on a very narrow range of criteria (cf. Intili and Flood, 1976). It could therefore be argued that both the emphasis on convergent thinking and the monolithic way in which programs are executed in the classroom would affect the performance of the bilingual/

bicultural child--turning their initial advantages into disadvantages. Similarly, it would appear that the child of limited proficiency is denied opportunity to develop existing skills further. Effort seems to be directed instead toward "curing" linguistic and academic skill deficiencies.

The type of cognitive outcomes which should be reflected in classrooms are precisely those which have been identified by cognitive psychologists (Chipman, et al. 1980) as important for cognitive development. Reviewing the writings of Guilford (1959); Bloom (1956); Suchman (1962); Taba (1966); and writers in the more popular domain such as; Postman and Weingarter (1969); or Kohl (1973); one easily detects a common commitment to the idea that developing children's intellectual or cognitive skills provides outcomes more applicable to a wide variety of life's situations than does a more direct information dispensing approach. In the 1930's, Smith and Tyler (1942) did a study identifying certain aspects of the thinking process and developing instruments to measure progress in mastering them. The concept of thinking was divided into three specific areas: inferring generalizations from specific data, applying principles to new situations, and critical thinking per se. Earlier, Dewey (1933) derived a theoretical model for scientific inquiry. Beginning with "suggestion," Dewey's model proceeds to describe the steps underlying inquiry as "intellectualization," "hypothesizing," "reasoning," and "hypothesis testing." Taba (1964, 1966) writes of problem-solving; Guilford (1959), and Gallagher

(1965) write of divergent versus convergent thinking; Suchman (1962) writes of inquiry; and Bruner (1966), following Piaget, considers stages of cognitive development. Even more recently, one finds a renewed interest in the development of programs aimed at improving thinking skills. Programs such as those suggested by Feuerstein (1979); Sternberg (1980); Wimby and Lockhead (1980); Lipman (1980) are a few examples. Unfortunately, however, these programs tend not only to be for older (i.e., beyond K-6) students, but have not been developed with the language minority student in mind.

Although the concept of teaching children to process information thus has a long history, evidence for its existence in classroom behavior or activities is relatively rare in the regular classroom, let alone in bilingual classes. Clark and Peterson (1976), for example, find that teachers are concerned mostly with the factual information in their lessons. Bellack et al. (1966) finds teachers predominantly using simple logic in their interaction with students. Surprisingly, consistent findings over a wide range of teachers, students, and settings seem to support the prevalent assumption that current classroom practice stresses facts and knowledge to the exclusion of more complex forms of information processing. Taba (1964) postulates that one reason for the low status of "thinking" follows from a belief that thinking is predicated on learning a body of factual knowledge--in other words, that one has to "know content" before one can think. Silberman (1970), Jackson (1968), and others argue that

"thinking" is difficult to teach in a classroom where the teacher is continuously forced to deal with management issues which tend to subordinate thinking to content. In this connection, it is quite easy to see how questions of language variability and other issues created by the presence of limited English speaking students in the class would only add to the difficulty of teaching and thinking skills in a classroom.

A rather different explanation for the failure of teachers to implement widely advocated curricula based on the "inquiry method" is offered by the organizational research of the Environment for Teaching Program at Stanford's School of Education. The teaching of such a curriculum requires a high level of rationalization and thoughtful discussion by the staff. Without input from staff members, teachers are left to deal with a demanding set of problems and have few resources to call on. Resources capable of providing staff support, adequate for such a demanding curriculum, include interdependence with other teachers, or close relationships with a specialist. This proposition is derived from the organizational generalization that complex tasks are best handled by complex, interdependent staff arrangements (Lawrence & Lorch, 1967; March & Simon, 1958; and Thompson, 1967). Futhermore, Intili (1977) has shown that interdependence among teachers is a very important predictor of the complex diagnostic-descriptive decision making advocated by Taba and others.

Whatever the reason(s), it appears that the curriculum

fare in classrooms serves similar dishes to most students, and that these dishes consist mostly of recall skills for factual information. The disadvantages of this approach are that it limits the commitment to individual growth and self-development so often expressed as a goal in writings on "good teaching" (see Intili and Flood, 1976), and actively discriminates against those students who do not share in the content referent (see De Avila and Havassy, 1975) embodied in the curriculum. Taba (1966), Guilford (1956), Suchman (1962), and others would also argue that such an approach limits the transference that comes from attainment of intellectual or cognitive skills which are applicable to a wide variety of situations by virtue of their "abstractness."

Thus, it would appear that linguistically different children are denied access to the more complex information processing approaches to learning by virtue of a generalized reluctance to implement this type of program as well as by a presumption that most linguistic and/or cultural deficits require direct remediation in the way of ESL or spiritual uplifting through programs which emphasize an appreciation of cultural heritage. Hence, one finds few bilingual programs which emphasize either mathematics (as opposed to computational skills) or science, and a continued belief in approaches predicated on compensatory models (Nieves-Squires, 1980).

By and in large measure, the approach embodied in the Finding Out/Descubrimiento activities (FO/D) derives its theoretical basis from the developmental work of Jean Piaget

in Europe,and the work on information processing and learning sets conducted in the United States. Space limitations, however, do not allow for a full discussion on all of the theoretical underpinnings upon which FO/D are based. At this juncture a brief discussion of some of the reasons why the FO/D activities were most appropriate for the MICA project's goals will serve to introduce the study.

In agreement with Piagetian theory, activities used in the MICA program represent an attempt to provide experiences which, in a non-punitive way, contribute both to intellectual development and academic performance. As such, most of the activities are not new. They have been selected from tasks normally found in the broad areas of science and mathematics. Each activity is seen as possibly contributing to an enrichment of the child's repertoire. More specifically, tasks were modeled after similar tasks found in programs such as the Newfield math program, Cuisinier Rods, Developing Mathematical Processes, Attribute Games and Problems, and so on. There are, nevertheless, significant differences regarding their use which distinguish the FO/D approach.

First, the task or set of tasks is not viewed as an end in itself. Instead, each task is viewed as a point of departure. In using the tasks, teachers were asked to build upon and extend the repertoire of the child by providing additional tasks whose "principle of solution" is the same as that embodied in the math/science activities (see Kohlberg

and Meyer, 1972).

Second, the tasks or activities are linked to qualitative differences in development. The tasks were selected on the basis of laboratory studies, existing programs, and direct experience which has shown them to be within the grasp of children of different developmental levels (see McRae, 1978).

Third, insofar as tasks were selected to cut across developmental levels in a Piagetian sense, it becomes possible to evaluate intellectual progress through the use of Piagetian developmental tests such as conservation (see De Avila and Pulos, 1978).

Fourth, activities have been related to certain aspects of traditional tests of academic achievement. In this way many of the skills assessed in typical achievement tests are embodied in the FO/D activities. Moreover, since many of the skills developed by the program are context free, it thus becomes possible to assess change through the use of standardized achievement tests (see Kaufman and Kaufman, 1972).

Fifth, by allowing children to work on tasks which are interesting in their own right, it becomes possible to include activities which require the use and development of basic skills. In this way, the child is learning and using the "basics" while at the same time serving his or her own purposes, since, at no time is the child left with the question, "Why am I learning this?" Instead, the answer to "why" becomes readily apparent; "so I can make a hot air balloon, or a

periscope, or applesauce" (see Kohlberg & Meyer, 1972).

Sixth, the activities and all materials are provided in such a way as to minimize the importance of language problems. In so far as the activities are presented in both languages and are accessible to all students, they tend to facilitate a great deal of discussion between students of different linguistic backgrounds. As a result, the increased verbal interaction tends to facilitate oral language development for both native and limited English speakers alike. It was in this final sense that the choice of the FO/D materials were seen as the most appropriate to a bilingual population. There did not seem to be any other existing programs which had been tried and with language minority populations (see, McRae, 1978).

In summary, the activities were selected in an attempt to provide a set of obtainable goals which were intended to enhance or enrich the child's level of intellectual, academic and linguistic functioning.

Three hundred and seven children in nine classes, grades 2 through 4, participated in the MICA project. The sample comprised nine schools in five school districts in the San José area. Five of these classes participated in an "intensive treatment" and four in an "economic treatment." The difference between the two treatments derived from participation by the "intensive" treatment teachers in two workshops dealing with teacher, teacher/aide work arrangements. Training in implementing the activities themselves was given to all teachers participating in the project as a group, regardless of treatment.

Sample selection proceeded through five stages. The first four concerned recruiting teachers to implement the activities, and the fifth concerned obtaining appropriate control subjects.

Access to the classrooms was gained through the Bilingual Consortium of San José. Under their aegis, an initial presentation was made to all 2nd through 4th grade teachers participating in the Consortium. This constituted the first recruitment phase. The presentation concerned: the nature of the curriculum, instrumentation used to assess outcomes, demands to be imposed on teachers, and what teachers would be receiving in return. This was accomplished in the Spring of 1979. At that time, potentially interested teachers were asked to complete a questionnaire concerning their prior

experience with learning centers, their work arrangements with an aide, and their math/science background. Project directors felt that it was critical for a teacher to work with an aide, for that work to include instructional issues, and for the teacher to have had at least minimally positive prior experiences with learning centers.

The second phase involved screening the questionnaires. All but one teacher who had indicated interest met the criteria described above.

Project concepts and design were then presented to the districts in which the teachers were located. This phase occurred during the summer of 1979, while the fall 1979/80 teacher and teacher/aide assignments were being formulated by the districts. During this phase, the project staff corresponded with potential teachers concerning progress in gaining acceptance of the project and the date for a pre-year, in-service training on the project activities.

The fourth phase involved in-service training with teachers who were to use the activities. In-service training had two parts. The first (the initial training) involved introducing the activities to the teachers, having the teachers work with the activities, an explanation of the rationale behind the activities and the project in brief, and a description of classroom management and recordkeeping associated with the activities. The second part was a follow-up session, conducted either in a group session or individually (depending

upon teacher availability--after the teachers had completed at least 3 weeks of the activities). Only one teacher who participated in the initial session did not sign up for project participation. The reason given was the heavy burden on teacher time by project. This teacher was not replaced because the year had started, and there was no time for a new recruit to obtain the same level of in-service training as those who had participated in the initial in-service training.

In summary, the sample of teachers using the activities consisted of 9 volunteer teachers who had, at least, some positive experience with learning centers and who worked with an aide who had, at least, some responsibility for instructional tasks. The decision of who would be in the "intensive" treatment and who would be in the "economic" treatment was made by random assignment. Once assignment was made, groups were examined to make sure they were roughly equivalent with respect to students' socioeconomic status and level of knowledge as indicated by number of children on the school lunch, and other similar programs.

The fifth stage concerned recruiting teachers for a control group. Initially, the design called for five control teachers with comparable classes on the above criteria. However, it was difficult to find teachers who taught science. Approximately 15 teachers were interviewed. It was found that teachers did not teach science in any systematic fashion and would, therefore, be of little use as a control group. Because of these problems, it was decided to use

several approaches to the post-hoc creation of controls. These will be described in greater detail in the appropriate analysis and results section of this report.

The following table provides subject breakdown by age/grade, school, and condition.

Insert Table 1 about here

Appendix A provides a more detailed description of each classroom participating in the study. In Appendix A, characteristics such as language patterns, socio-economic class, organizational features and other factors are described.

Instruments

Student progress was assessed on a pre/post basis. A variety of tests were used to assess gains in language, intellectual development, academic achievement and science concepts. In the following, each instrument will be described. It should be noted that with the exception of the science/math "Mini-test," all instruments were commercially obtained. Table 2 lists the specific tests and sub-tests.

Insert Table 2 about here

These measures were administered to all of the students participating in the study. The content and administration procedure for each test is described below.

Description of Instruments

The analyses summarized in this report utilize four instruments.

Table 1

Subject Breakdown

School	Grade	AGE (in months)	(SD)	N
(1)	2/3	97.11	(9.50)	28
(2)	3	102.60	(6.12)	23
(3)	4	116.04	(9.28)	26
(4)	3	104.63	(9.60)	32
(5)	3	105.04	(11.60)	25
(6)	3	103.26	(6.58)	27
(7)	2/3	103.32	(9.57)	31
(8)	3	103.93	(7.71)	27
(9)	3/4	111.06	(9.23)	32
Total		105.24	(10.17)	253

Table 2 - Instruments

I. Language
Language Assessment Scales (LAS)
A. Comprehension
B. Production

II. Intellectual Development
Cartoon Conservation Scales (CCS)
A. Length
B. Number
C. Substance
D. Distance
E. Horizontality
F. Egocentricity
G. Probability
H. Volume

III. Achievement
California Test of Basic Skills (CTBS)
A. Reading
Vocabulary
Comprehension
Total Reading
B. Math
Applications
Concepts
Computation
Total Math

IV. Science and Math
MINI I & II, and MINI III
A. Vocabulary
B. Concepts
C. Concrete Applications

These include measures of learning outcomes (California Test of Basic Skills; MICA MINI-test developed by the project to measure learning specific to the activities); a measure of language proficiency (Language Assessment Scales); and a measure of intellectual development of the child (Cartoon Conservation Scales).

Measures of Learning Outcomes. Two forms of the California Test of Basic Skills (CTBS) were used to measure academic achievement: Level 1, Forms S and T for the third and fourth graders; and Level C, Form S for the second graders. These tests already were in use by a majority of the participating school districts prior to the MICA project. In some cases, Form S was used for the pre-test and Form T was used for the post-test. Where this was done, an adjustment was made in the child's score to take into account the difference in the norms between the forms. The CTBS was administered to children participating in the project, either by the school district or by the project (the latter was for four teachers) in English. Students who could not speak enough English to answer the items on the first page of the test were not administered the test.

The MICA science test (MINI-test) consists of three sections: vocabulary, concepts, and concrete application; and is designed to be specific to Finding Out/Descubrimiento. Parts I and II use a multiple choice procedure and are group-administered. The total test time requires approximately 40

minutes. Parts I and II are presented in both pictorial and written formats; these are read to students, thus reducing or minimizing reading difficulties. The test is administered in the language appropriate to the child. Scores are reported as number correct/number answered, which converts unanswered items to missing data rather than errors. For the present purpose, Parts I and II were combined as a single score.

Part III takes about 20 minutes per child to complete. Each child is presented with thirteen tasks to perform representing understanding of the concepts of solid and liquid measurement, using instruments calibrated on the metric system, spatial configuration, weight and mass, graphing, and probability. Students exhibit their proficiency with these concepts in the performance of these tasks and are scored as having mastered the concept or not. The tester tries to go beyond superficial understanding of the concept by probing the underlying reasoning. The test attempts to avoid a multiple choice framework and tries to encourage a student to demonstrate transfer of training. Scores are reported as number correct/ total number administered. This third part the MINI-test was administered to a subsample of the total group only. The sample was selected on the basis of language proficiency. Eight children in each class were selected to include monolingual English, monolingual Spanish, and mixed or limited in language proficiency in both languages. The resulting distribution of students based on language proficiency on

the pre-test is summarized as follows:

Language Proficiency	No. of Students
Minimal language	6
Limited bilingual	19
Partially bilingual	10
Monolingual in English	23
Monolingual in Spanish	9
Bilingual English and Spanish	2
Total	69

Because of the small number of proficient bilingual, monolingual Spanish, and "limited language students," it was necessary to fill out the subsample with partially or English monolingual students in order to avoid empty cells.

Language. Oral language proficiency in both Spanish and English was assessed by means of the Language Assessment Scale (De Avila & Duncan, 1977). The test represents a convergent procedure consisting of the following subtests: oral production (story retelling), phoneme discrimination (minimal pairs) and production, vocabulary, and oral comprehension. The combined subtests yield a composite score which represents the student's level of oral language proficiency corresponding to totally fluent English, near fluent English, limited English, non-English with partial English language deficiency, or non-English with total English language deficiency. Scoring of the LAS production was done outside of the project by non-MICA staff who scored results without prior knowledge which tests were pre or post. In this way,

experiemental bias was left to a minimum, since the tests were scored blind.

Intellectual Development. The Cartoon Conservation Scale (De Avila et al. 1976; De Avila and Pulos, 1978; Fleming and De Avila, in press), assesses intellectual development. The CCS are a collection of Piagetian tasks which are group administered by means of cartoon format. In all, the CCS has 32 dichotomously scored items with eight subscales including conservation and length, number, substance, distance, horizontality, volume, egocentricity, and probability.

The concepts embodied in the CCS no doubt more closely resemble the various general definitions on "thinking skills" than any of the other outcome measures used in this research. However, insofar as the CCS tasks are not directly taught as part of the FO/D curriculum, they should be considered as a measure of the extent to which concepts learned in the curriculum have "generalized" or transferred. For a more detailed discussion of the relationship between Piagetian tasks and the general notions embodied in "thinking skills," see Bruner, Olver and Greenfield (1966).

Achievement. Two forms of the California Test of Basic Skills (CTBS) were used to measure achievement: Level 1, Form T for the third and fourth graders; and Level C, Form S for the second graders. These were the tests already in use by the majority of the participating school districts before we entered.

Finally, it is important to bear in mind that the CTBS is made up of two major sections, reading and math. The reading section is broken down into vocabulary and comprehension subtests. Math is broken down into three subscales: computation, concepts, and applications. These subscales differ, not only in content, but the processes required to learn them. For example, reading vocabulary and math computation more closely represent paired associate or rote learning, whereas, the learning required for reading comprehension, math concepts and applications more closely approximates the process of "concept formation" as described by any number of researchers (see Bourne, 1966). It can, therefore, be expected that with regard to traditional notions of scaled achievement, the FO/D activities will have a stronger impact on these subtests as opposed to those requiring less in the way of thinking skills.

II. Results

The analyses of data were conducted using a computation to univariate and multivariate techniques. The summary which follows is presented in three major sections. While the data are rich and offer a wide variety of possibilities, the major emphasis in the following summary will focus on the extent to which participation resulted in significant gain on the major variables under study.

In the first phase of the analyses, pre/post $\bar{X}$ and SD's were calculated for each outcome measure by conditi n.

Several ANOVA (2-way; time x condition) were then run to examine relative pre/post gain by condition. Insofar as test (i.e., outcome measures) were not of any particular interest in their own right, a 2-way ANOVA (condition x time) was run for each outcome measure separately. These were then followed by a second set of 2-way analyses of covariance (using pre-test scores as a covariant) in which the effect of sex, school, and age differences are examined.

In the second major section, an attempt is made to compare MICA pre/post scores for students with those obtained by three different comparison groups. As will be seen, each group was defined in a slightly different manner. For example, in the first series of this phase of the analyses, MICA student pre/post performance on the CTBS are compared with fall and spring publishers' norms. In a second series of analyses, MICA student performance on the CTBS is compared with the performance of a similiar group of 200 children participating in a bilingual program.

In this series of analyses, comparisons between groups are made relative to publisher fall and spring norms. Thus, publisher norms are treated as "expected scores" relative to the actual scores obtained by MICA and comparison groups. In a final set of analyses for this phase, MICA student performance was compared with a sub-group of students participating in the MICA project who were expected by their teachers to experience difficulty in the program.

In the third and final section of this report, a series of analyses are made in which a number of interrelations between the eight test measures are examined. This analyses is followed by a concluding set of analyses in which an attempt is made to examine a number of linguistic issues which consider English and Spanish oral language proficiency simultaneously. As will be seen, each of the following analyses focuses as an attempt to identify or describe the impact of the program in a quantitative fashion. In an attempt to "round out" the picture with more qualitative information, Appendix A provides qualitative summary of each classroom participating in the study. These class by class descriptions provide information as to a number of student, teacher/aide, classroom, school, and community social factors thought to be of possible importance in understanding the data as a whole. While these direct observations are not discussed in any detail, they are nevertheless provided as an appendix to this report.

The 2-way ANOVA summary provided on Table 3 shows a significant, main-effect by condition on: CTBS reading and math; LAS (English); MINI(English); and MINI (Spanish). Pre/post significant differences were found in all cases with the exception of the CCS and Spanish LAS scores. Significant interactions between condition and time were statistically significant only in the case of the CCS (F=4.80: P=.035). Using $P < .05$ as a criteria, there was a significant main effect by condition in 5 of the 8 analyses conducted. Time

(i.e., pre vs. post) differences resulted in significant main effects in 6 of the 8 analyses.

Comparison of cell means, (see table 4) reveals that, for the most part, the intensive group had slightly higher pre-test scores on tests with the exception of the LAS (English and Spanish). With respect to the CCS, the significant interaction between condition and time is explained by the fact that the intensive improved almost twice as much as the economic. Thus, while there were no significant mean differences between the two groups on the pre-test (i.e., 19.87 vs. 19.51), there were on the post-test (24.93 vs. 22.16). A simple test of significance revealed the post-test difference to be significant at the .001 level.

Insert Table 3 about here

Insert Table 4 about here

In a second series of analyses, several sets of analyses of covariance were conducted. These results are summarized on Table 5. Inspection of the results for condition reveals a significant main effect on CTBS math, CCS, English, and Spanish MINI (1+2) and English LAS, but not on CTBS reading, Spanish LAS, or MINI-3. As will be recalled, mean scores by condition were presented for each test on Table 4. Graphic display of these means are provided for each test on Figures

TABLE 3

2-WAY ANOVA (CONDITION X TIME)

SUMMARY

Variable		F	Sig
CTBS READING			
	Condition	4.84	.028
	Time	46.28	.000
	Condition x Time	1.18	.291
CTBS MATH			
	Condition	31.58	.000
	Time	102.62	.000
	Condition x Time	.55	.458
CCS			
	Condition	.37	.541
	Time	2.04	.154
	Condition x Time	4.80	.035
ENGLISH LAS			
	Condition	2.06	.156
	Time	15.53	.000
	Condition x Time	2.93	.088
SPANISH LAS			
	Condition	31.82	.000
	Time	1.44	.231
	Condition x Time	.73	.395
MINI (ENGLISH)			
	Condition	3.91	.048
	Time	25.81	.000
	Condition x Time	.77	.381
MINI (SPANISH)			
	Condition	3.78	.050
	Time	3.50	.065
	Condition x Time		
MINI-3			
	(English & Spanish Combined)		
	Condition	.03	.868
	Time	26.80	.000
	Condition x Time	.01	.931

TABLE 4
PRE/POST MEANS, SD's &
LEVEL OF SIGNIFICANCE FOR
DEPENDENT MEASURES BY
CONDITION

	Pre		Post	
	$\bar{X}$	SD(N)	$\bar{X}$	SD(N)
Condition		CTBS READING		
Intensive	29.46	18.3(121)	41.80	20.7(126)
Economic	25.60	16.1(81)	36.48	19.3(95)
Total	27.90	17.5(202)	39.52	20.1(221)
		CTBS MATH		
Intensive	45.38	20.2(119)	65.72	19.8(118)
Economic	36.29	12.2(70)	53.89	19.2(87)
Total	42.01	18.1(189)	60.68	20.4(205)
		CCS[3]		
Intensive	19.87	5.7(138)	24.93	4.6(138)
Economic	19.51	6.1(106)	22.16	6.0(106)
Total	19.72	5.9(244)	23.75	5.4(250)
		ENGLISH LAS		
Intensive	67.91	22.0(139)	73.42	21.8(144)
Economic	69.04	18.1(115)	74.14	18.6(115)
Total	68.40	20.3(254)	73.73	20.4(259)
		SPANISH LAS		
Intensive	54.32	31.0(140)	56.07	31.5(143)
Economic	41.26	28.7(117)	44.12	30.8(115)
Total	48.33	30.6(257)	50.76	31.7(258)
		MINI 1&2 (ENGLISH)		
Intensive	50.60	12.5(90)	62.12	13.2(101)
Economic	47.10	11.0(82)	54.62	12.1(87)
Total	48.90	11.8(172)	56.61	11.7(188)
		MINI 1&2 (SPANISH)		
Intensive	41.69	8.1(49)	48.70	10.9(44)
Economic	38.84	9.3(27)	41.14	11.6(28)
Total	40.67	8.5(76)	45.81	11.9(72)
		MINI 3 (ENGLISH & SPANISH COMBINED)		
Intensive	66.02	12.9(36)	75.03	13.0(36)
Economic	60.20	13.8(30)	74.91	13.7(30)
Total	63.37	13.5(66)	74.88	13.3(66)

1 to 8.

As can be seen, Figures 1 and 2 show similar gains for both English and Spanish oral proficiency. Analysis of covariance (covarying pre-test scores) results (see Table 4) revealed that condition had a negligible effect on Spanish and a significant effect on English ($P < .05$). It is of some interest to note that there is a substantial difference between intensive and economical groups on Spanish and virtually no difference on English. With respect to intellectual development, results of the analysis of covariance revealed the condition to be highly significant ($P < .000$). Mean score comparisons shown on Figure 3 show that while there were substantial gains for both groups, where pre-test scores were almost identical (intensive = 19.8 vs. economical = 19.6), there was a difference of almost three points in the post-test. Whereas condition seemed to have a negligible effect on reading ($P. = .15$), it did significantly impact math achievement ($P < .001$). Mean score comparisons provided on Figures 4 and 5 show, as in the case of Spanish oral language proficiency, that intensive condition students received somewhat higher scores in both pre and post-tests. The effect of condition on performance on the content referenced MINI-test was significant on both English ($P < .000$) and Spanish ($P. = .01$) versions. As in the cases of Spanish oral language proficiency, reading and math achievement, children in the intensive condition received higher scores in both pre and post-tests.

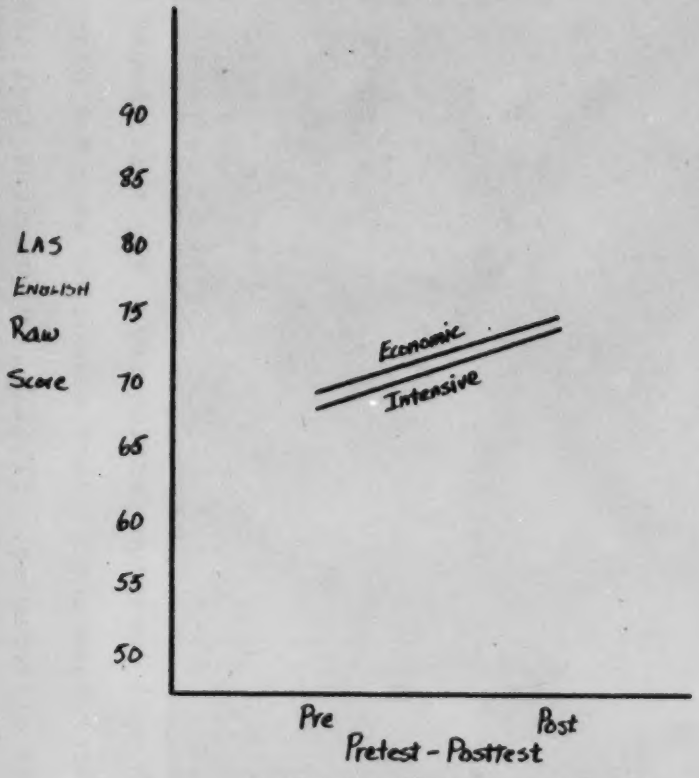
Although condition seemed to have a negligible effect on reading scores, it did seem to positively effect math scores.

Finally, results provided on Table 5, show condition to have had a significant effect on MINI-3 scores. Figures 8 graphically illustrates this effect. As can be seen, there was approximately a six point difference between intensive and economic groups at the pre-test. This difference was virtually eliminated by the post-test.

Insert Figures 1 through 8 about here

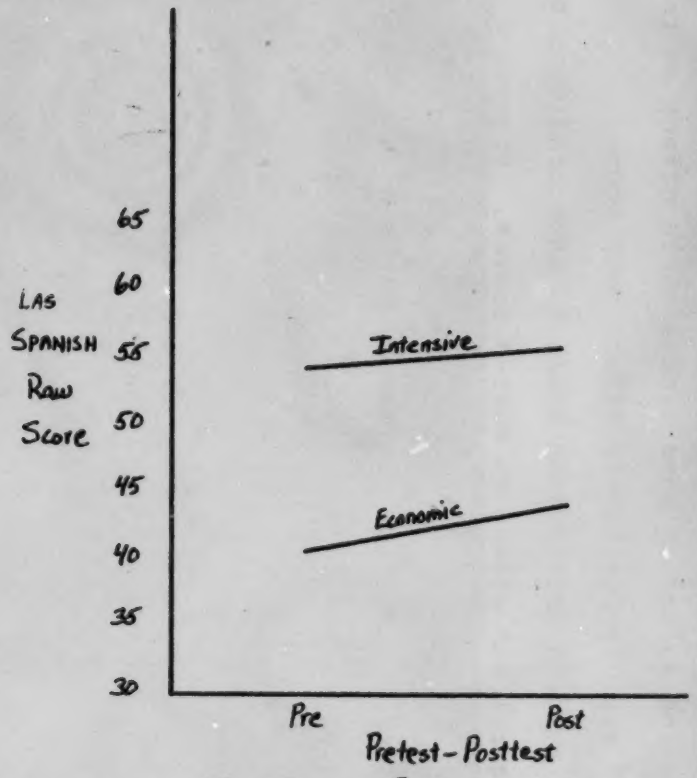
Insert Table 5 about here

In summary it would appear that condition had a significant effect in five out of the eight analyses where $P<.05$ is used as criteria for determining level of statistical significance. Conversely, in the cases of Spanish oral language proficiency, reading achievement and MINI-3 results were not statistically significant. It is noteworthy that the intensive group received higher scores in both pre and post-tests in all instances except English oral language proficiency. Why this should be is unknown since class and subject selection were not based on any of these differences. Finally, in previous analyses,



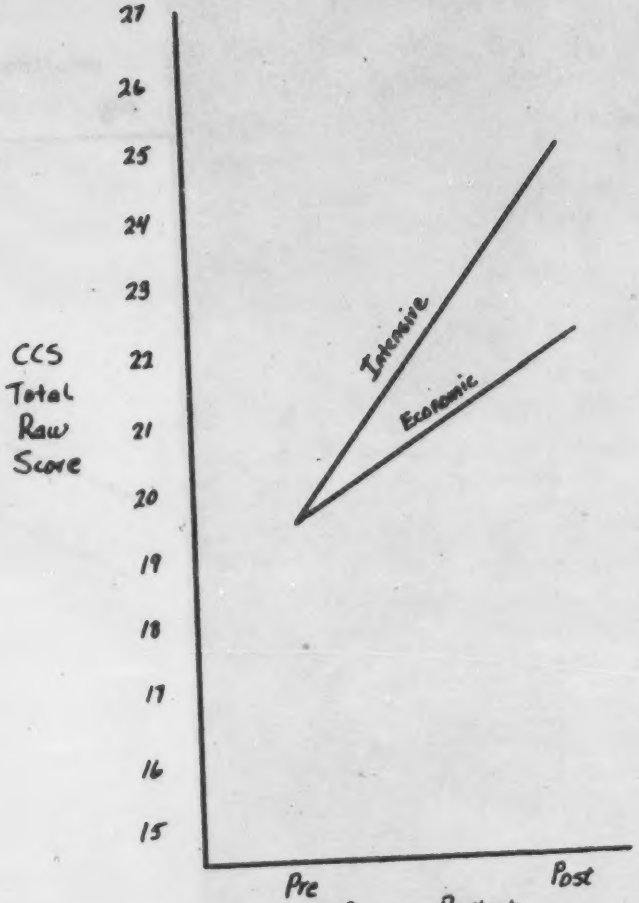
Oral English Proficiency X Condition

Figure 1.



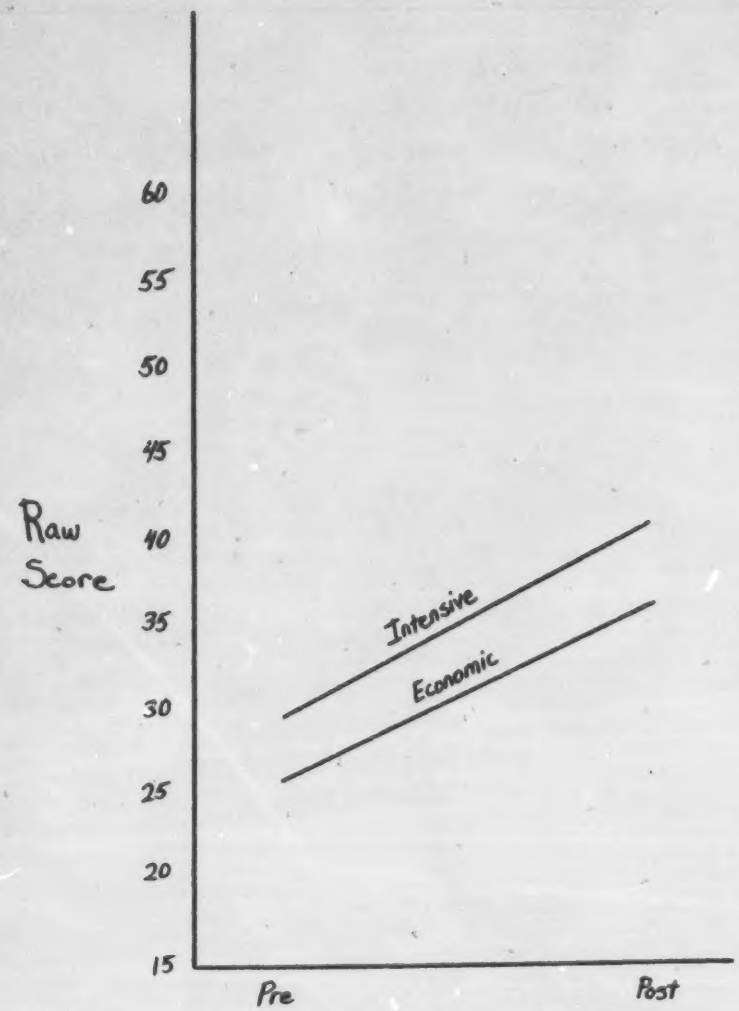
Oral Spanish Proficiency X Condition

Figure 2.



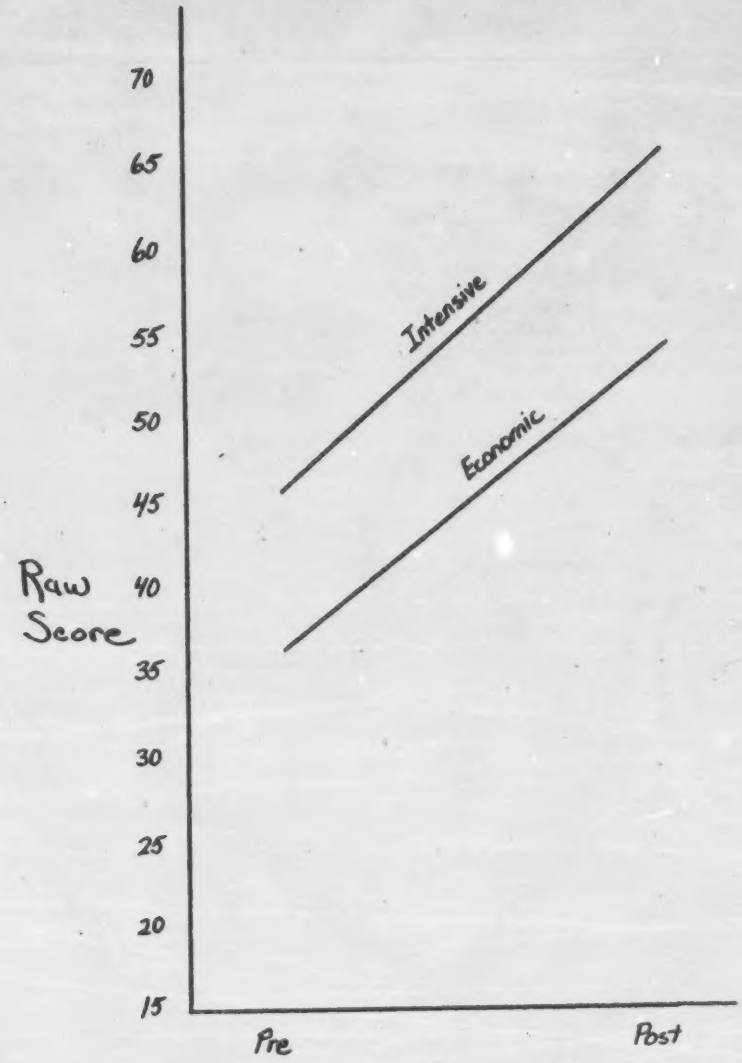
Pretest-Posttest
Intellectual Development X Condition

Figure 3.



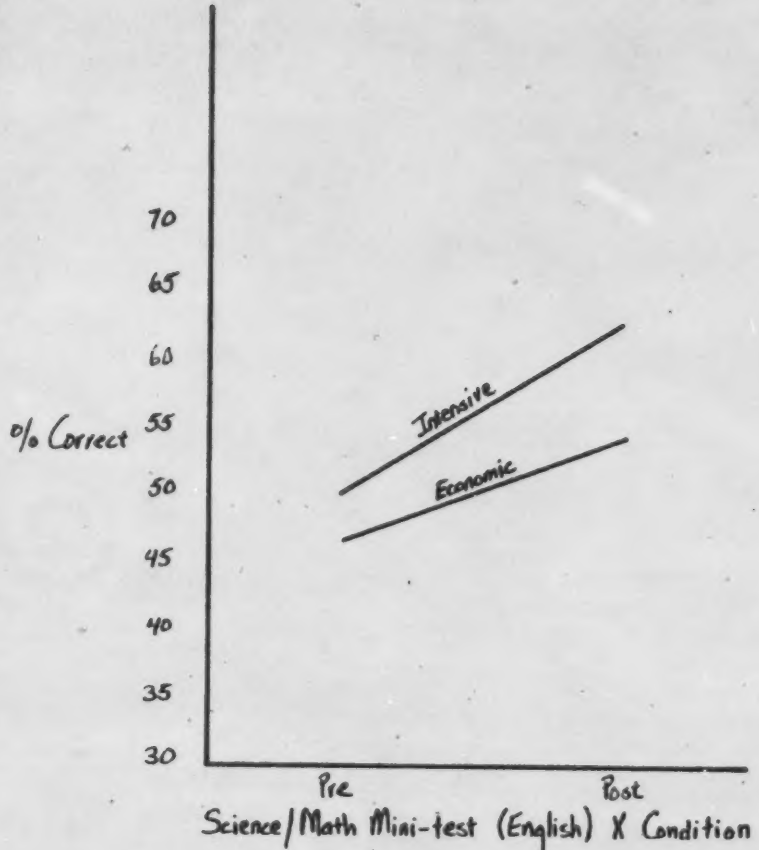
Total Reading X Condition

Figure 4.



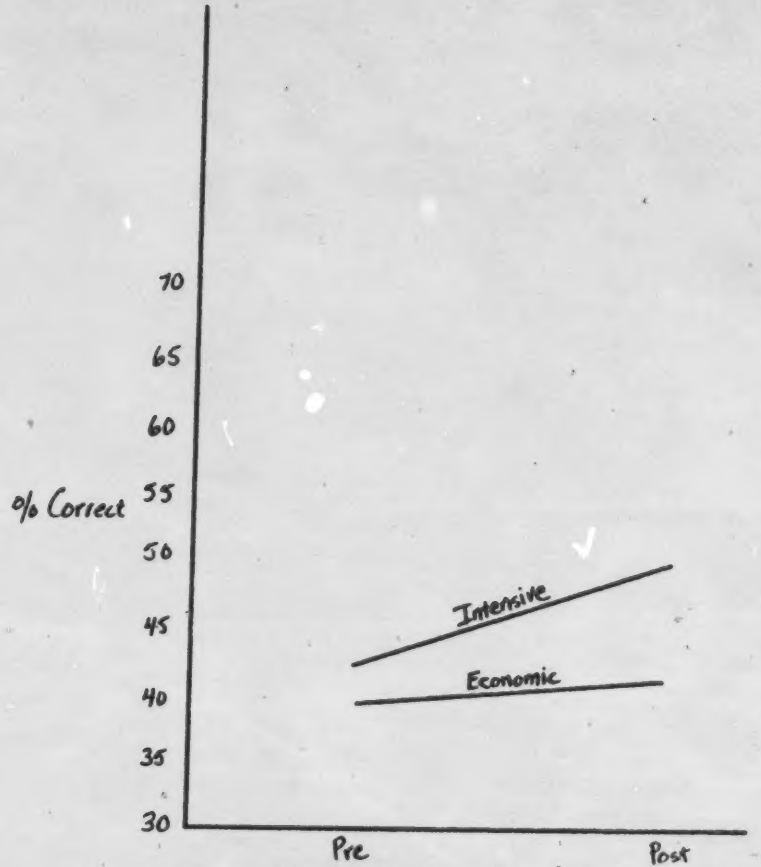
Total Math X Condition

Figure 5.



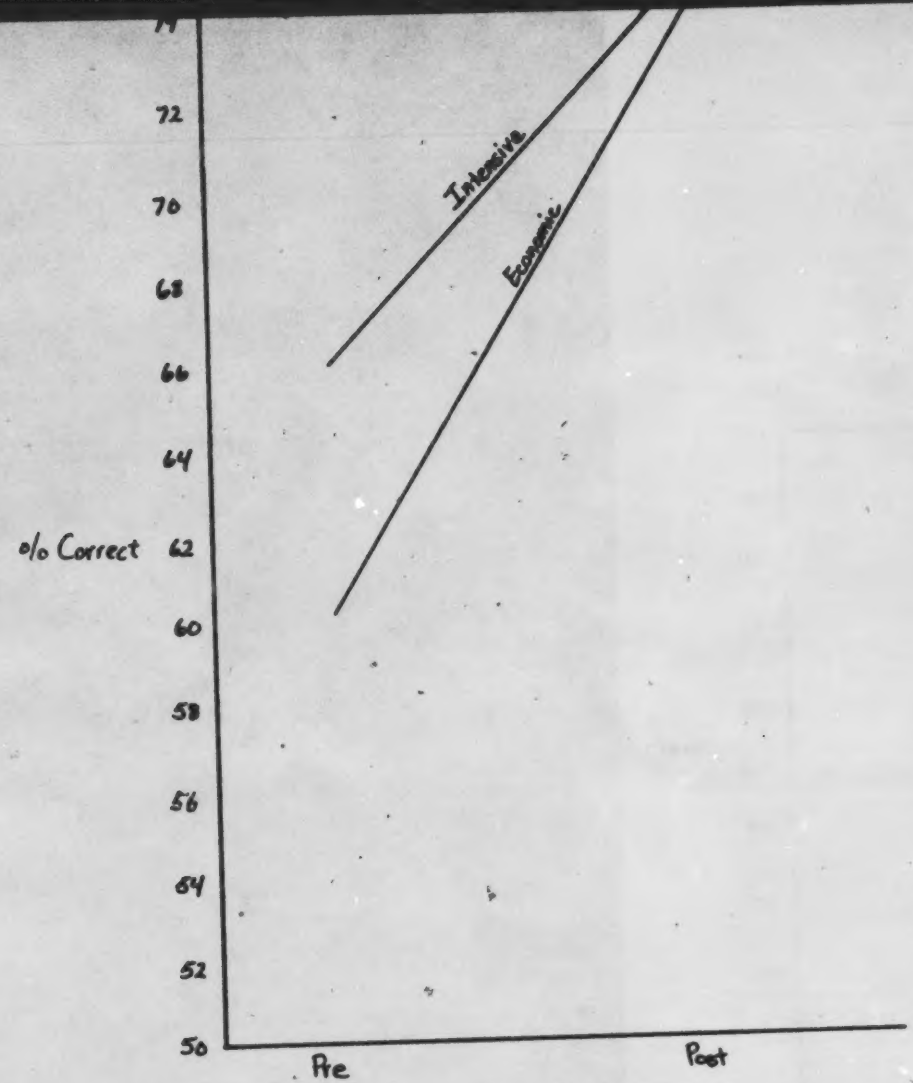
Science/Math Mini-test (English) X Condition

Figure 6.



Science/Math Mini-test (Spanish) X Condition

Figure 7.



Mini - III X Condition

Figure 8.

TABLE 5

SUMMARY OF ANALYSIS ON
COVARIANCE (Pre-test Scores As Covariant)

		F	P-level	R2
CTBS READ:	Condition	2.13	.15	.69
	School	1.51	.16	.71
	Sex	2.45	.11	.69
	Age	392.85	.00	.71
CTBS MATH:	Condition	8.01	.00	.49
	School	5.83	.00	.60
	Sex	4.93	.03	.49
	Age	132.71	.00	.47
CCS:	Condition	15.30	.00	.38
	School	2.63	.01	.40
	Sex	4.22	.04	.34
	Age	97.51	.00	.33
ELAS:	Condition	3.89	.05	.57
	School	2.02	.05	.60
	Sex	.71	.38	.57
	Age	278.13	.00	.58
SLAS:	Condition	.49	.48	.82
	School	.71	.69	
	Sex	1.45	.23	.82
	Age	929.74	.00	.81
EMINI-1:	Condition	23.02	.00	.61
	School	3.28	.00	.62
	Sex	1.10	.30	.55
	Age	178.21	.00	.56
SMINI-1:	Condition	7.62	.01	.34
	School	6.22	.00	.59
	Sex	.00	.98	.24
	Age	17.39	.00	.36
EMINI-3:	Condition	.038	.55	
	School	Not run by school or age because of small "N's."		
	Sex			
	Age			

results show consistent positive gains for both groups across pre and post test comparisons.

In the final portion of this section, the effect on sex and age differences are examined as possible modifier variables

School effects were examined in the same way as the effects of condition. These results are also summarized on a Table (see Table 6 for $\bar{X}$, SD's) and reveal significant results for English language proficiency, intellectual development, math, and both English and Spanish MINI tests. Results failed to show significant effects for Spanish oral proficiency and reading. These results are in no way surprising, since "school" and "condition" are fundamentally the same variable. An examination of Figures 9 through 14 does, however, indicate that there was substantial school-by-school variation, both in pre and post-test gains, as well as total points gained between pre and post-testing. Thus, Figure 9 shows absolutely no difference in pre/post oral language proficiency scores for school #8, a drop in scores for school #7, and positive gains for the remaining seven schools. In the case of Spanish oral proficiency, there were consistent positive gains in seven out of nine schools.

In the remaining instances, an examination of Figures 11, 12, 13, and 14 reveal consistent positive gains in all nine schools across intellectual development, reading, math and science/math MINI-tests. It would thus appear that while there were significant school effects, there were also consistent gains between pre and post-test scores across the seven dependent

measures in all but a few schools. The extent of these gains

Insert Table 6 with Footnotes about here

Insert Figures 9 thru 14 about here

seems to be somewhat variable, depending on base levels as well as on other factors not discussed in the present report. Finally, with respect to the above analyses by school, results on the Spanish MINI-test were not presented graphically since, in some cases, there were only a few subjects. By the same token, this analysis was not conducted on the MINI-3 because of the small numbers of students within each school who took it.

Turning to the question of sex differences, significant differences between boys and girls were found in two cases; these involved CCS or intellectual development ($P = .04$) and math achievement ($P = .03$). In the case of intellectual development, an examination of pre/post test means for boys vs. girls shows gains of 4.08 and 3.88 respectively. Since the difference in absolute value between these scores is 1/5 of a point, the psychological significance of this difference should seem minimal. With regard to the significant difference between boys and girls on the math achievement test, examination of pre/post means shows that the boys gained 18.71 points, whereas the girls gained 18.59. This difference, which is less

TEST SCORE MEANS BY SCHOOL

CTBS READING[1]

	PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
B	33.75	46.47	18.5	(16)	20.9	(17)
C	33.96	41.32	15.7	(23)	16.8	(28)
S	29.19	42.83	16.4	(27)	22.2	(29)
A	16.17	28.62	11.5	(23)	15.4	(28)
Mc	20.50	29.33	12.5	(26)	20.1	(27)
G	27.86	29.78	14.8	(14)	17.5	(23)
O	23.71	42.92	15.8	(14)	17.8	(13)
W	27.57	43.44	15.5	(28)	18.6	(27)
M	36.48	53.75	23.1	(31)	18.0	(28)

CTBS MATHEMATICS[2]

	PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
B	42.13	67.71	16.5	(16)	21.1	(17)
C	46.39	60.50	11.0	(23)	20.6	(28)
S	48.38	66.62	20.9	(26)	18.4	(29)
A	27.31	47.84	9.5	(16)	15.2	(25)
Mc	26.52	56.10	8.5	(25)	14.6	(20)
G	32.90	44.05	9.9	(10)	18.9	(19)
O	42.14	82.69	12.9	(14)	13.8	(13)
W	39.29	56.59	8.3	(28)	16.8	(27)
M	58.77	70.56	23.1	(31)	19.8	(27)

MINI ENGLISH[3]

	PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
B	52.58	61.18	10.8	(19)	11.0	(24)
C	54.08	65.77	10.3	(23)	9.7	(28)
S	50.92	63.23	10.9	(20)	12.7	(21)
A	40.61	47.60	6.5	(21)	10.4	(24)
Mc	44.37	58.88	9.0	(18)	8.1	(19)
G	45.33	51.67	7.8	(14)	8.6	(14)
O	42.95	51.70	11.7	(17)	15.4	(18)
W	49.15	56.72	13.0	(28)	12.7	(25)
M	63.54	70.33	12.4	(12)	14.0	(15)

MINI SPANISH

PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
33.92	36.39	5.5	(4)	17.8	(5)
65.00	63.33	0.0	(1)	2.4	(2)
41.00	54.87	4.7	(8)	12.4	(8)
38.77	42.69	7.5	(11)	9.8	(7)
41.20	45.15	6.4	(9)	8.9	(9)
40.50	41.77	11.1	(13)	10.0	(12)
41.51	41.05	9.8	(12)	7.8	(9)
---	40.67	----	----	12.1	(5)
41.16	51.22	7.8	(18)	9.3	(15)

MINI III INTERVIEW[4]

PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
57.89	75.19	10.5	(7)	12.1	(7)
70.39	83.55	10.5	(8)	7.7	(8)
64.04	76.69	13.5	(6)	10.0	(7)
58.55	85.53	15.8	(8)	6.1	(8)
63.16	65.13	12.9	(7)	10.1	(8)
63.24	73.68	18.8	(8)	14.6	(8)
60.15	65.13	13.2	(7)	14.9	(8)
60.90	63.91	9.5	(7)	13.0	(7)
70.76	84.85	14.2	(8)	5.2	(8)

LAS ENGLISH[5]

	PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
B	70.00	72.90	20.1	(28)	24.5	(29)
C	76.67	83.67	12.3	(24)	13.9	(30)
S	68.29	71.66	21.0	(24)	16.0	(29)
A	63.83	72.48	23.1	(29)	22.1	(31)
Mc	66.50	63.31	17.8	(26)	20.6	(26)
G	64.93	74.19	15.0	(30)	14.4	(26)
O	65.68	72.04	24.7	(31)	24.3	(28)
W	77.28	77.20	8.0	(29)	8.99	(30)
M	64.78	74.73	27.8	(33)	28.1	(30)

LAS SPANISH

PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
38.14	44.03	28.8	(28)	32.5	(29)
25.21	29.23	23.5	(24)	29.9	(30)
55.92	59.83	26.5	(24)	28.7	(29)
49.61	51.97	24.6	(31)	27.1	(31)
58.89	65.88	32.3	(27)	23.1	(25)
54.67	59.65	25.2	(30)	28.1	(26)
69.35	68.21	29.3	(31)	26.2	(28)
22.38	24.00	26.1	(29)	24.9	(30)
57.70	58.80	27.3	(33)	32.8	(30)

CCS[6]

PRE MEAN	POST MEAN	PRE SD	PRE (N)	POST SD	POST (N)
19.60	23.03	7.4	(25)	6.8	(31)
21.27	26.67	5.4	(22)	4.3	(30)
20.43	25.31	5.3	(28)	4.1	(29)
16.57	20.45	5.2	(30)	5.5	(29)
30.30	24.69	5.2	(27)	4.4	(26)
20.75	22.88	5.3	(24)	5.0	(25)
15.61	22.86	5.7	(28)	5.0	(22)
21.64	22.31	5.2	(28)	6.0	(29)
21.69	24.66	5.5	( )	4.9	(29)

Footnotes for Table 6

[1]The CTBS Reading score combines the subtests of vocabulary and comprehension. These are raw score figures with a maximum of 40 points for vocabulary and 45 for comprehension. The test was McGraw-Hill's Comprehensive Test of Basic Skills, Level 1, Form S.

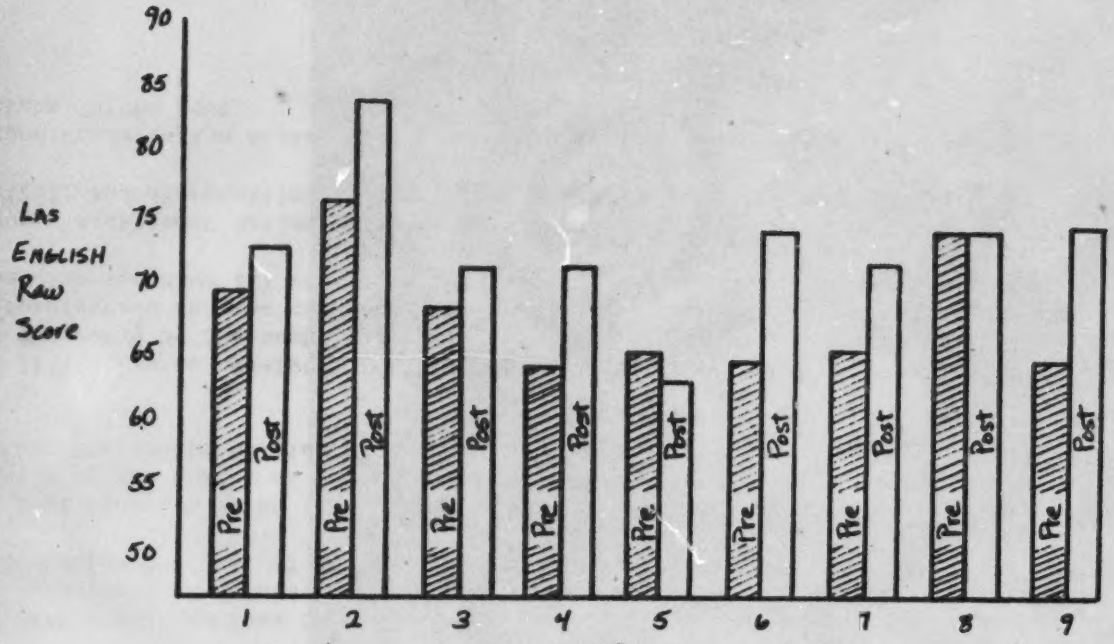
[2]The CTBS Math score combines the subtests of computation, concepts and applications. These are raw score figures with a maximum of 48 points for computation, 25 for concepts and 25 for applications. The test used was McGraw-Hill's Comprehensive Test of Basic Skills, Level 1, Form S.

[3]The MINI test consists of 60 items. The individual scores are calculated by dividing the number of items answered correctly by the number of items answered, with the result being multiplied by 100. The students took the test in either English or Spanish; the criterion for selection was the language with which they were most comfortable.

[4]The MINI III interview consists of 19 items. The individual scores are calculated by dividing the number of items answered correctly by the number of items answered with the result being multiplied by 100. The test was individually administered and was given to only a subset of targeted students from the sample. Therefore all results dealing with the MINI III will have considerably smaller Ns than the other data.

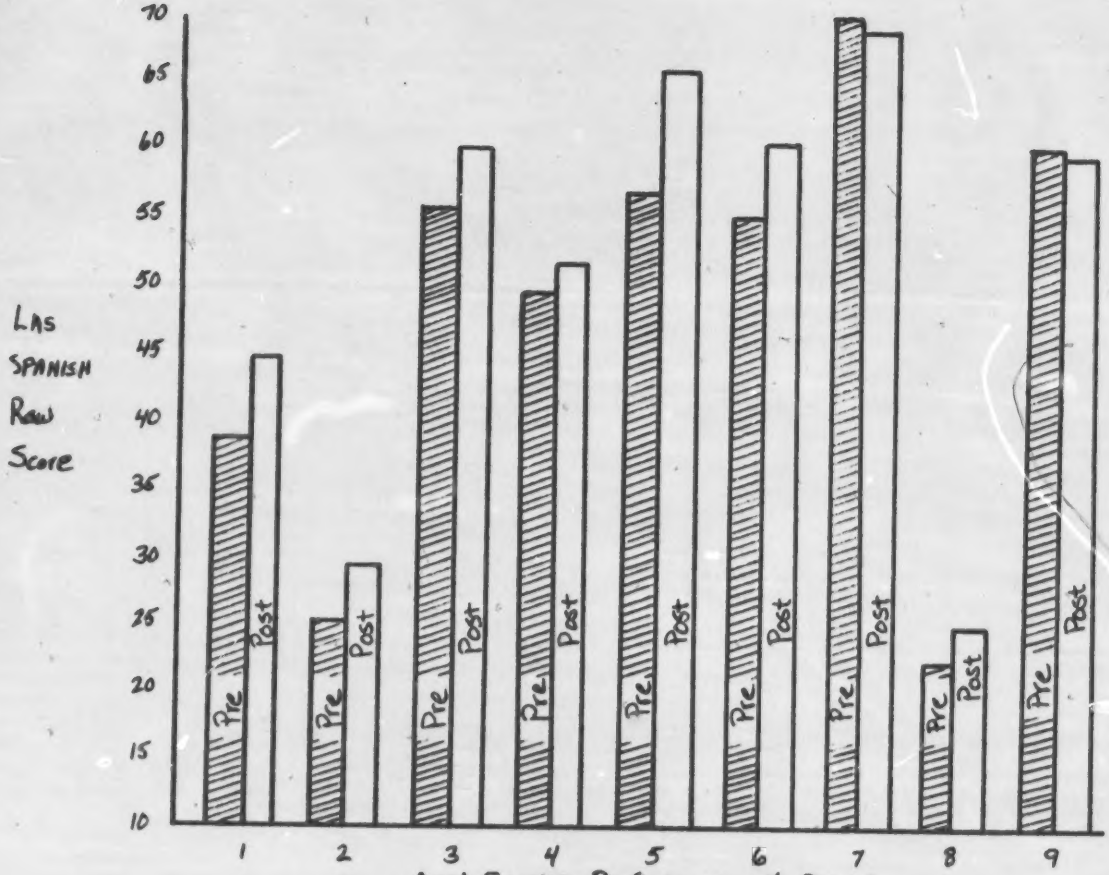
[5]The Language Assessment Scales (LAS) is a weighted score ranging from 1 to 100 which combines sentence comprehension (25%) and storytelling (preoduction - 75%). Each child was tested in both English and Spanish.

[6]The Cartoon Conservation Scale (CCS) test score is a simple count of the number of items answered correctly. There are 32 items in the test.

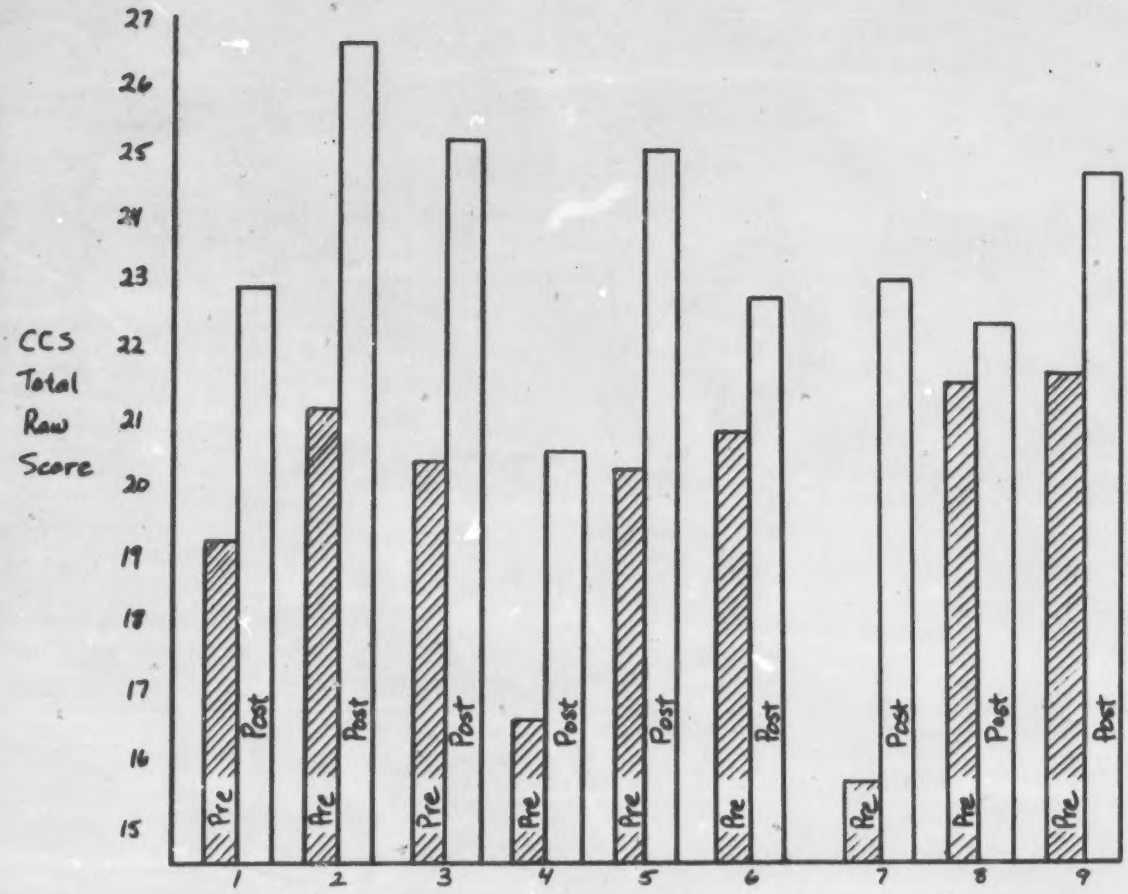


Oral English Proficiency X School

Figure 9.



Oral Spanish Proficiency X School
Figure 10.



Intellectual Development (CSS total) X School

Figure 11.

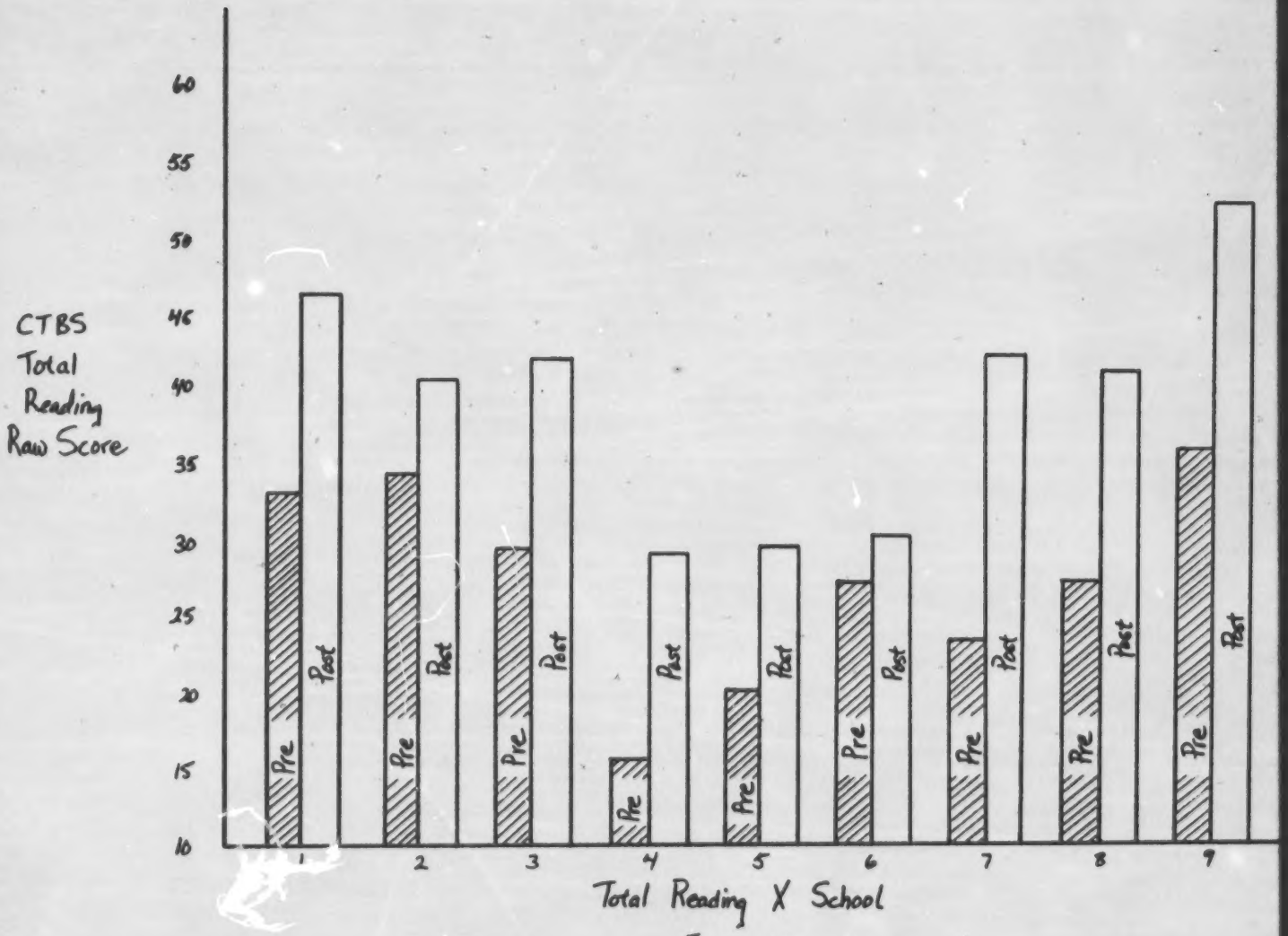

CTBS
Total
Reading
Raw Score
60
55
50
45
40
35
30
25
20
15
10
Pre
Post
1
2
3
4
5
6
7
8
9
Total Reading X School

Figure 12.

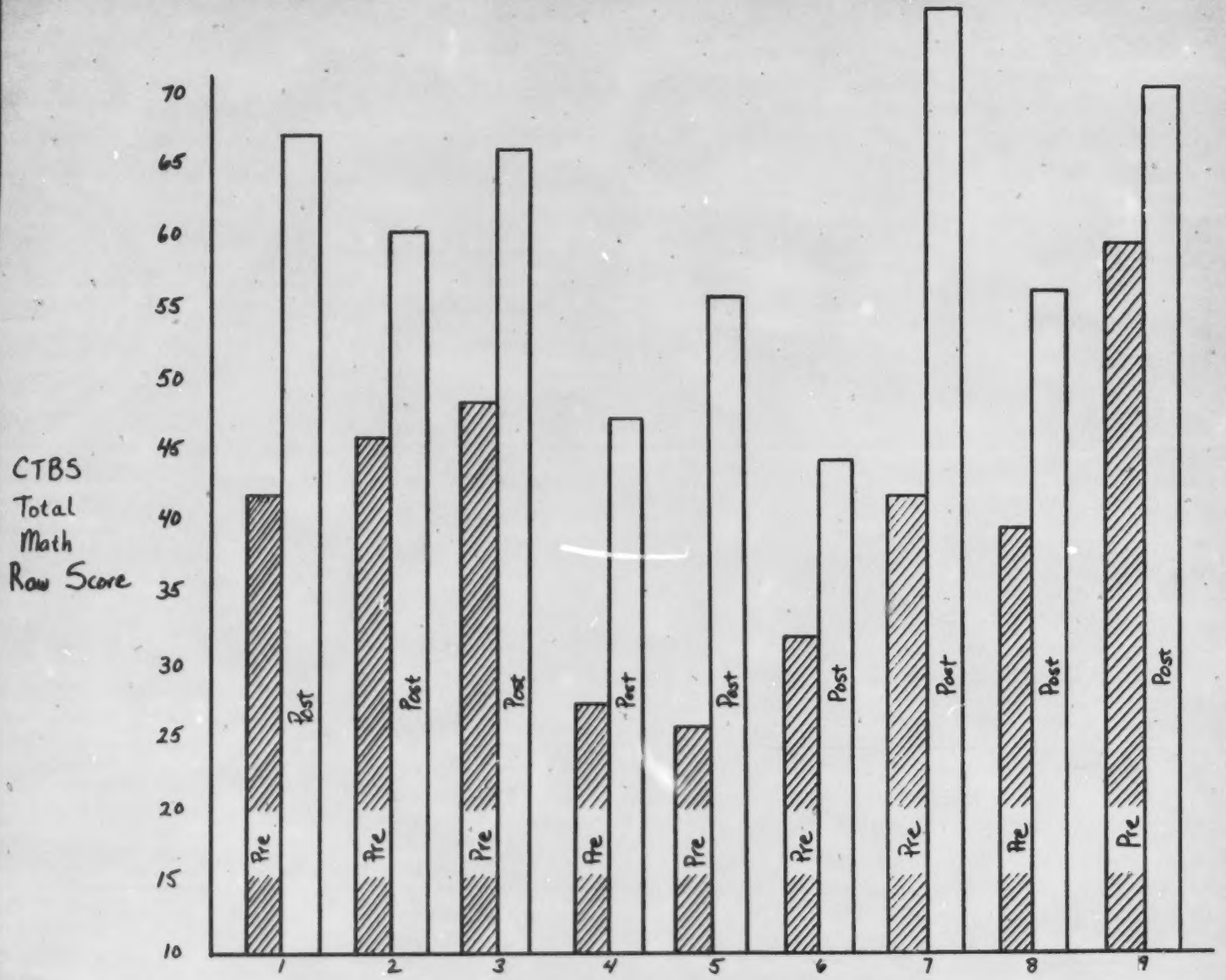

CTBS
Total
Math
Raw Score
70
65
60
55
50
45
40
35
30
25
20
15
10
Pre
Post
1
2
3
4
5
6
7
8
9
Total Math X School

Figure 13.

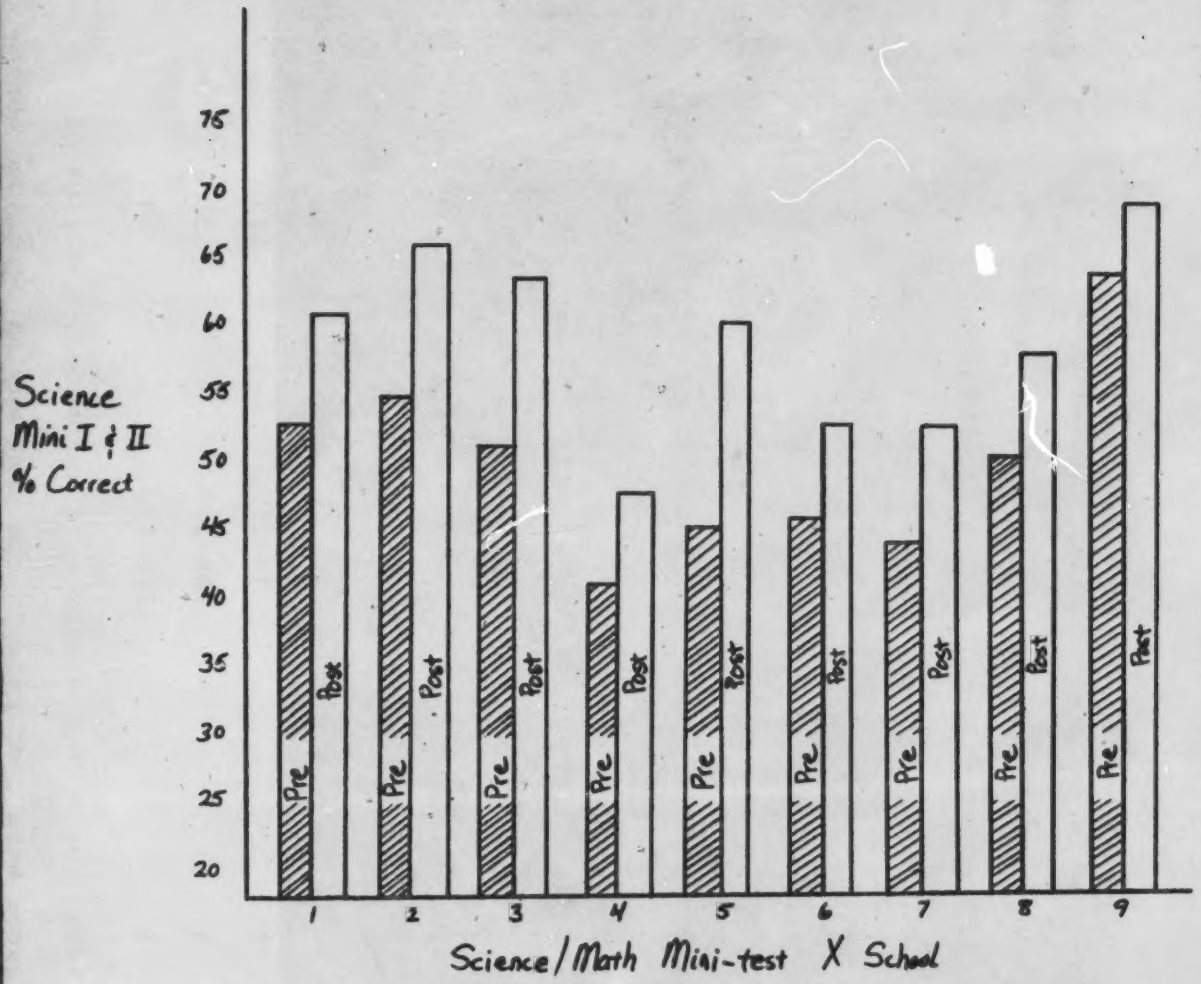

Science
Mini I & II
% Correct
75
70
65
60
55
50
45
40
35
30
25
20
Pre
Post
1
2
3
4
5
6
7
8
9
Science/Math Mini-test X School

Figure 14.

than a point, would also seem to be of little, if any, real significance. In summary, there seems to have been no difference in gain scores which is attributable to sex differences, particularly, since in the two cases where statistical differences were found, the difference in absolute value was less than a point which would be less than the standard error of measure for either test. Graphic illustrations of pre/post scores for boys vs girls are therefore not presented. While it is no doubt true that age and grade are highly correlated, it was decided to analyse the data on the basis of age difference rather than grade. This decision was predicated on a consideration of a significant number of studies which have shown tremendous overageness for language minority children throughout the United States (see Carter & Segura, 1979 for a review). The total MICA sample was, therefore, broken down into four groups on the basis of age in months as follows:

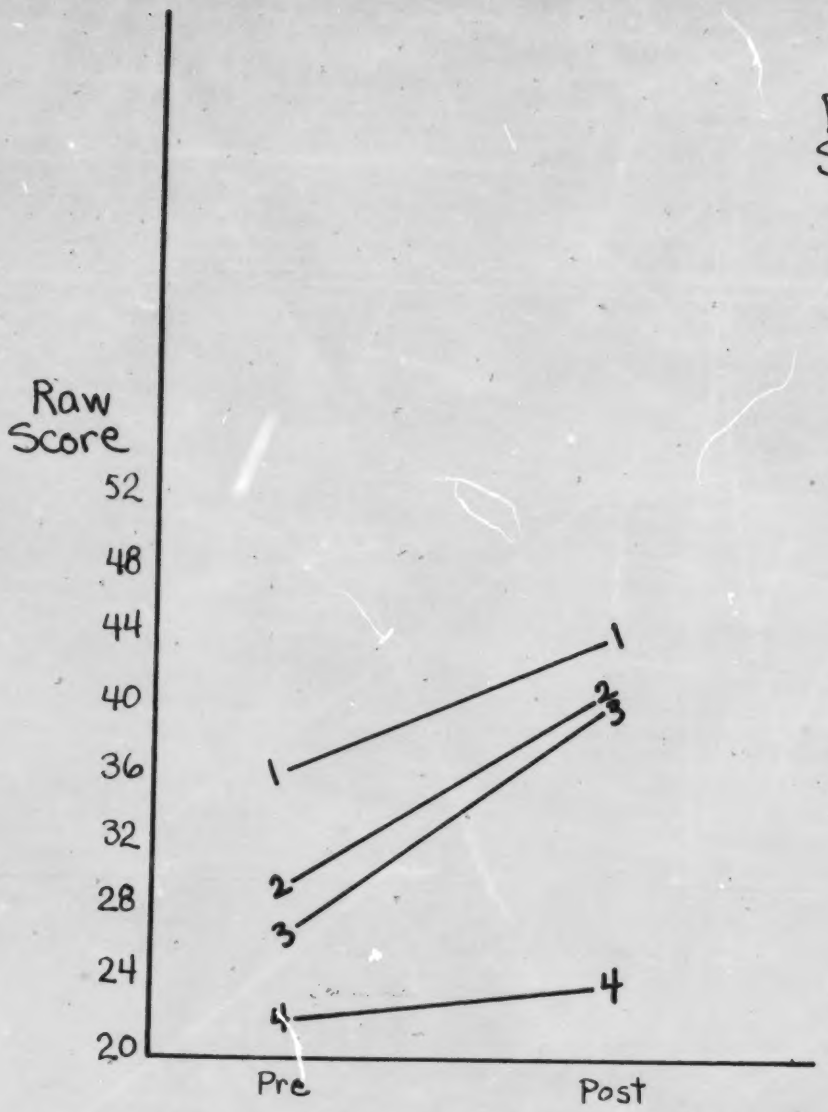
Group	Age in Months	# of Students
1	80- 95	20
2	96-107	125
3	108-119	51
4	120-180	19

After these four groups were generated, analyses of covariance were conducted in the same way as described above. Results provided on Table 6 indicate a significant age effect for all seven analyses. Figures 15 through 20 provide a graphic

illustration of these effects. With respect to CTBS reading (see Figure 15), Group 4 which was clearly older than the average MICA participant seemed to show the least gain. In fact, there was only a two point difference between pre and post-test for this group. CTBS math scores (see Figure 16), on the other hand, seem to be fairly consistent in the positive direction with Group 1 gaining somewhat more than the three older groups. CCS scores, shown on Figure 17, reveal consistent positive results for all four groups with Groups 2 and 4 gaining slightly more than Groups 1 and 3. Insofar as Group 1 was made up of the youngest students, slightly lower scores are to be expected.

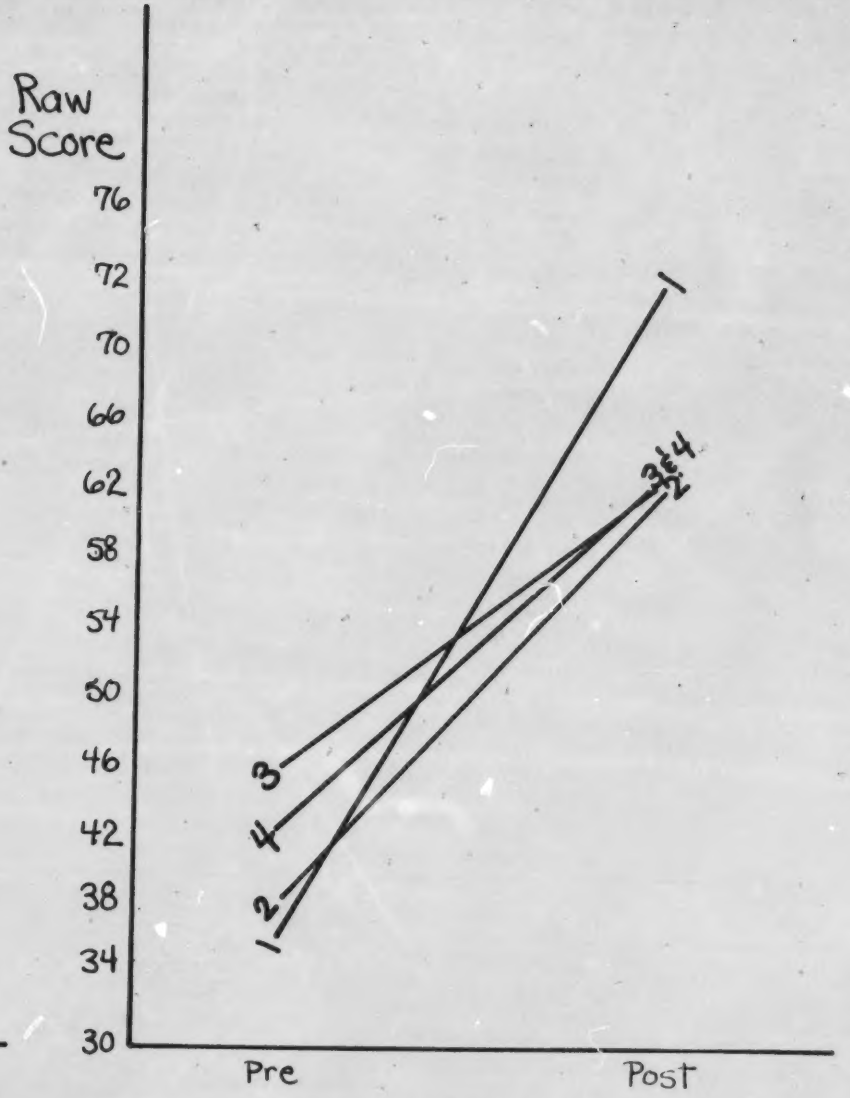
Turning to the interaction between age and oral language proficiency, the results show figures for English and for Spanish which indicate substantial differences between the four groups. First, it is indeed noteworthy the pre/post performance of Group 4 was substantially below that of the other groups. Moveover, not only was it substantially below that of the other groups, but it remained basically unchanged. The same point might be made in connection with the performance of Group 1 students who also did not improve. However, the important point would seem to concern the extremely low scores for Group 4 relative to the other three who are substantially more proficient and native like. To some extent, the low performance of Group 4 becomes understandable through an

Insert Figures 15 thru 20
about here



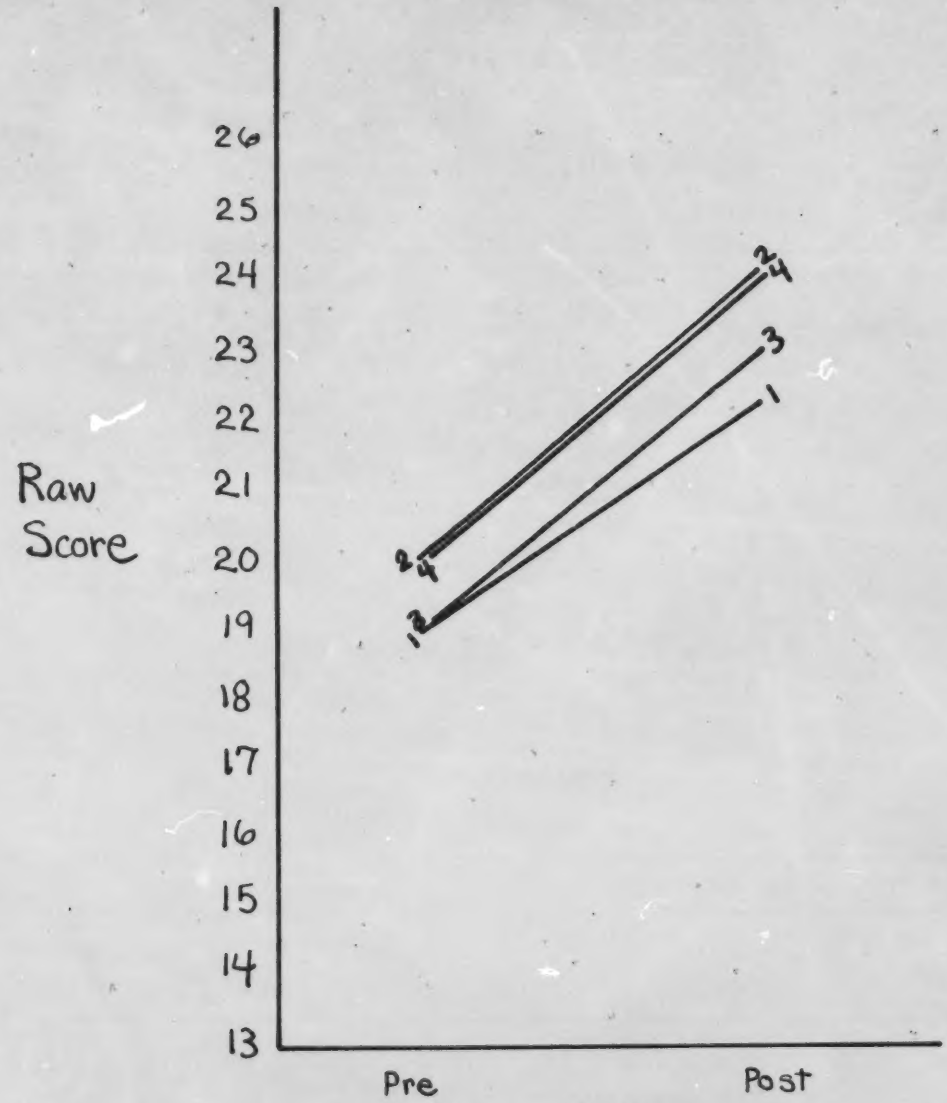
CTBS Total Reading
X
AGE

Figure 15

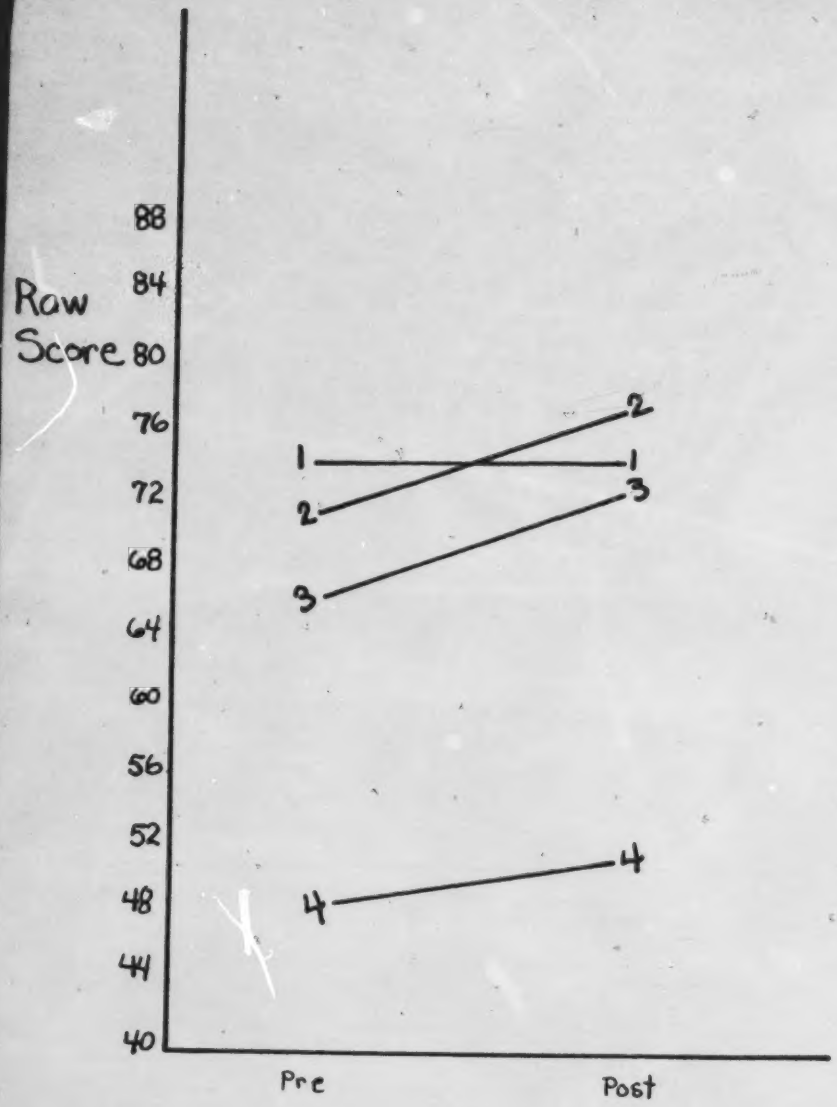


CTBS Total Math
X
AGE

Figure 16

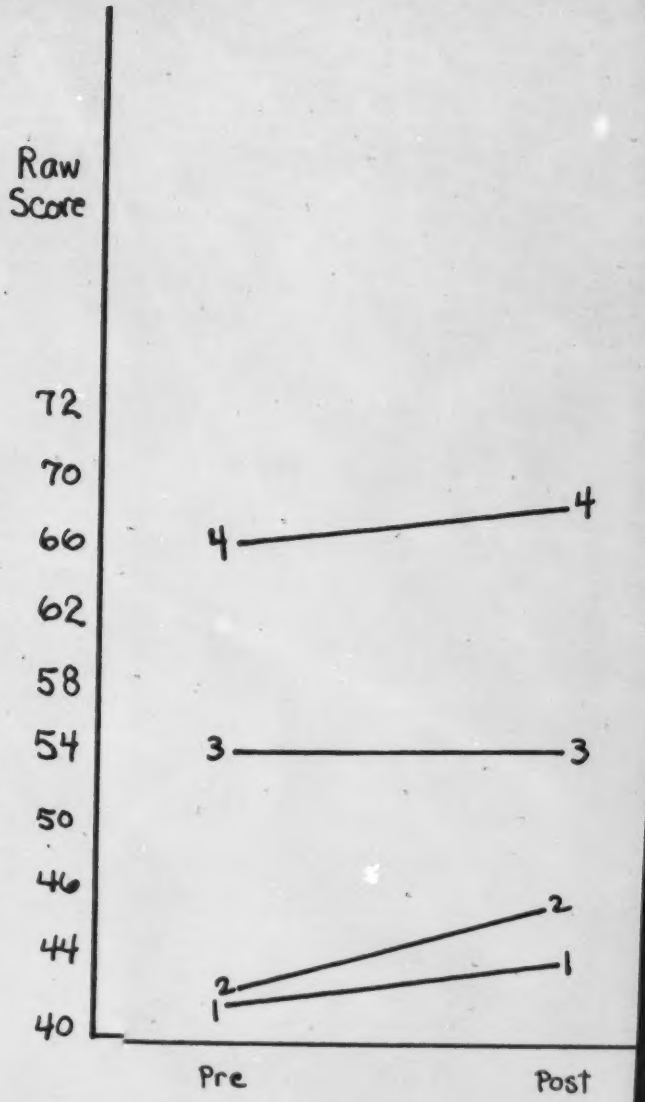


CCS
X
AGE
Figure 17



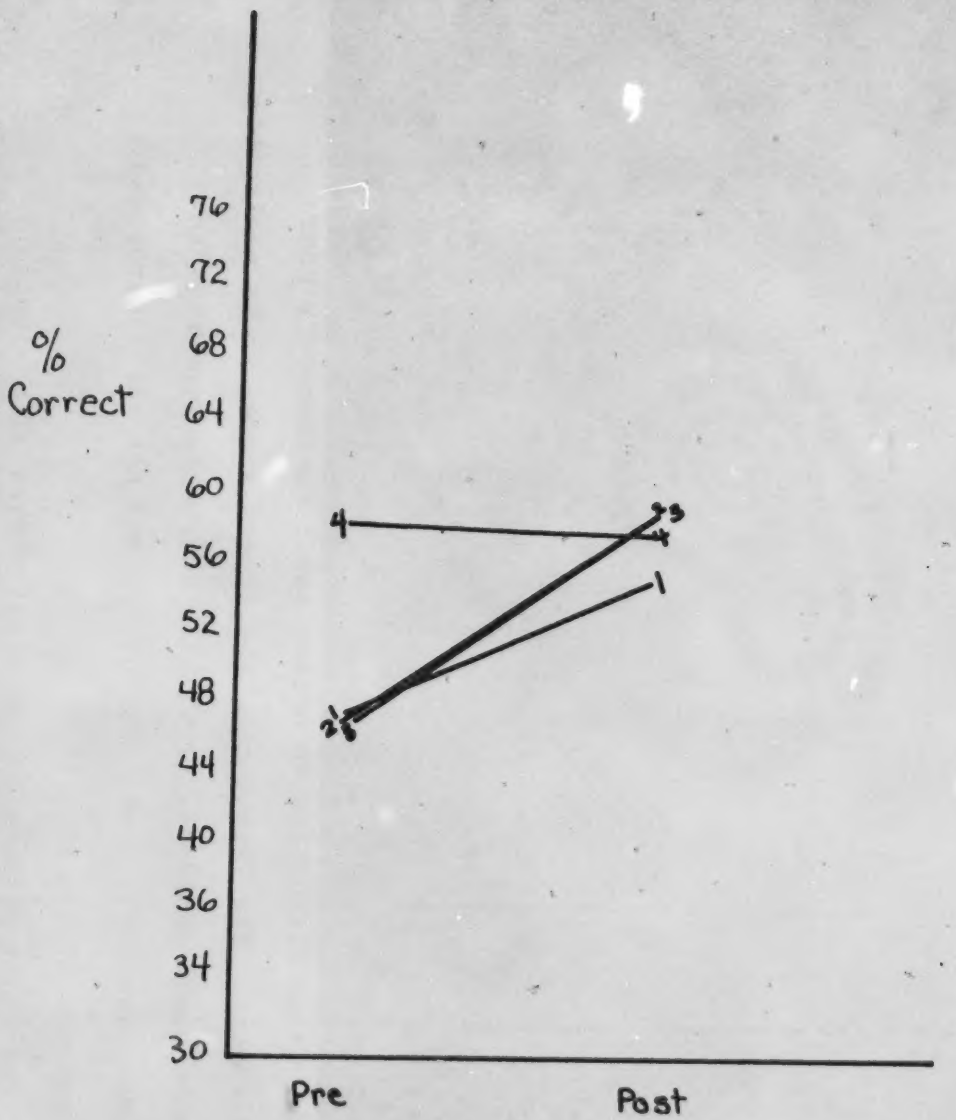
Total LAS Score (English)
X
AGE

Figure 18



Total LAS Score (Spanish)
X
AGE

Figure 19



Mini Test
X
AGE
Figure 20

examination of the results on Spanish oral language proficiency, shown on Figure 19, where they are substantially higher than Groups 1, 2, and 3. In fact, taking both sets of data into account, the results would seem to suggest that Group 4 is made up of primarily Spanish monolingual students.

Examination of pre/post performance on the science/math MINI (1 & 2) (see Figure 20) across the four age groups reveals the disturbing finding that the performance of Group 4 children was unaffected by programatic influence. In fact, if there was any change at all, it tended to be in a slightly downward direction.

The results of these analyses would seem to suggest that to some degree, at least, the significant age effects revealed in the analyses of covariance are accounted for by the low overall performance of the fourth age group. While they constitute a relatively small percentage of the total MICA group, it is disturbing to notice their consistently poor performance. For this group, the impact seemed to be negligible. In subsequent analyses, it will be extremely important to document and explain why this group, and not the others, did not respond to the program.

The major purpose of the first series of analyses, described in the above section, was to examine the extent of the program influence on eight outcome measures. In addition, a secondary purpose was to determine the extent to which treatment outcomes were significantly influenced by such

factors as school, sex and age. In summary, it can be said with few reservations, the program had a significant effect on the overall performance of students on all but one of the eight outcomes measures (i.e., Spanish LAS). In fact, in virtually all tests requiring the application of thinking skills, students in both intensive and economic conditions improved. While results were to some extent variable between schools, positive changes were observed in all but a few cases. Moreover, in those cases where improvement was low, it tended to be on variables which were of lesser importance to the overall purpose of the study, (i.e., to impact cognitive levels as assessed by CCS, MINI test, and to a lesser extent CTBS reading and math).

Norm and Control Group Comparisons. The traditional approach to the examination of program effects usually involves a comparison of pre/post test scores between treated and non-treated groups. This type of experimental vs. control group design is often difficult to effect in an applied setting. There are several reasons. First, in many cases, where the treatment involves working with low-achieving children, random assignment to treatment and control groups is illegal since it denies services to the controls who may have the same needs as those assigned to the experimental or treatment group. Another reason why it is difficult to use some of the more traditional laboratory designs concerns the fact that schools are often unwilling to go through the inconvenience of pre

and post-testing without being provided with some form of service. Moreover, teachers and administrators as well, already feel overburdened by mandated test requirements. The addition of tests which are specific to evaluate treatment effects are therefore seen as simply overloading the system. Finally, based on direct interviews throughout the area, it was virtually impossible to find comparable schools which included science as part of the daily curriculum in any systematic way.

Even though direct comparisons are difficult, if not impossible to obtain, one might argue that it is of little value to show statistically significant gains for treatment subjects between pre and post-tests, as was done in the above, without some form of comparison with a norm or reference group (Kerlinger, 1973 p. 331).

Given the problems in obtaining appropriate comparison subjects, while at the same time needing to demonstrate or test the significance of the above described findings with some form of referent group, the following section will describe the results of several such attempts. Unfortunately however, comparative data were available for only the CTBS, which, as mentioned above, is perhaps not the most appropriate outcome measure. In this context, a series of pre/post test comparisons were made between MICA and a group of children particapating in a "compensatory" bilingual program in the same area as the MICA schools. This series of analyses

involves pre/post comparisons between the two groups which attempts to take into account expected gains represented by the fall/spring publisher norms. These analyses are followed by a second set in which the performance of the total MICA group is compared with a sub-group of MICA students who, according to teacher judgments, were expected to experience difficulties in achieving.

Table 7 summarizes the $\bar{X}$ and SD's for MICA participants in comparison to: (1) Spring and fall raw score norms (equivalent to the 50th percentile, and (2) A group of children of similar background, in the same grades, who were participating in the same bilingual consortium from which MICA schools were selected. It should be noted the results are presented for third and fourth grade students separately, because different test forms were used by the comparison group. As can be seen, Table 7 shows that on the vocabulary section of the CTBS, the norm fall raw score is 18, and 23 in the spring.

Insert Table 7 about here

Thus, a gain of 5 points would be expected between fall and spring testing. This gain may be compared to the gain experienced by experimentals. As can be seen, on the vocabulary subtest the comparison group had a fall mean of 13.23 and a spring mean of 17.02. It can be observed that they gained 3.79 points between fall and spring testing, which roughly corresponds to the treatment time period for the participating MICA students. The gains of norm and comparison groups may be directly compared

TABLE 7

$\bar{X}$, SD's & N's FOR MICA & COMPARISON SUB-GROUP (WITH FALL/SPRING 50th%ILE RAW SCORE EQUIVALENTS)

	Pre			Post		
	Norm	Control	MICA	Norm	Control	MICA
THIRD GRADE			VOCABULARY			
$\bar{X}$	18	13.23	12.13	23	17.02	18.91
SD	NA	6.02	8.69	NA	7.90	8.28
N	NA	118	137	NA	118	136
			COMPREHENSION			
$\bar{X}$	19	12.63	14.34	26	18.95	20.71
SD	NA	7.18	4.66	NA	9.98	5.29
N	NA	116	134	NA	116	134
			TOTAL READING			
$\bar{X}$	37	25.97	26.92	49	36.21	40.07
SD	NA	11.95	17.11	NA	16.64	15.54
N	NA	116	133	NA	116	133
			MATH COMPUTATION			
$\bar{X}$	23	17.49	18.06	34	31.26	31.86
SD	NA	7.71	7.85	NA	10.78	10.86
N	NA	118	136	NA	118	136
			CONCEPTS			
$\bar{X}$	15	10.57	11.24	18	13.70	15.30
SD	NA	4.44	5.27	NA	4.97	5.17
N	NA	110	130	NA	110	130
			APPLICATIONS			
$\bar{X}$	11	7.05	7.90	15	10.55	12.37
SD	NA	4.27	4.64	NA	5.40	6.08
N	NA	102	117	NA	102	117
			TOTAL MATH			
X	49	36.29	38.98	67	56.75	60.31
SD	NA	12.22	13.68	NA	17.04	19.66
N	NA	99	116	NA	99	116
FOURTH GRADE			VOCABULARY			
$\bar{X}$	25	17.50	13.82	29	22.54	22.80
SD	NA	7.83	9.33	NA	8.55	9.28
N	NA	1.84	39	NA	184	39
			COMPREHENSION			
$\bar{X}$	31	18.32	18.13	35	24.34	26.36
SD	NA	8.93	11.70	NA	10.40	11.86
N	NA	182	39	NA	182	39
			TOTAL READING			
$\bar{X}$	56	35.76	31.95	64	46.72	49.08
SD	NA	15.79	19.86	NA	16.69	20.58
N	NA	182	39	NA	182	39
			MATH COMPUTATION			
$\bar{X}$	39	30.88	30.18	42	38.24	39.26
SD	NA	11.65	11.57	NA	8.87	9.34
N	NA	183		NA		

TABLE 7

	Pre			Post		
	Norm	Control	MICA	Norm	Control	MICA
			CONCEPTS			
$\bar{X}$	19	NA	13.98	21	NA	17.29
SD	NA	NA	6.86	NA	NA	5.59
N	NA	NA	39	NA	NA	39
			APPLICATIONS			
$\bar{X}$	17	NA	10.65	20	NA	15.73
SD	NA	NA	7.02	NA	NA	6.26
N	NA	NA	37	NA	NA	37
			TOTAL MATH			
$\bar{X}$	75	54.92	56.24	83	68.24	72.92
SD	NA	19.32	22.31	NA	17.59	17.12
N	NA	182	37	NA	182	37

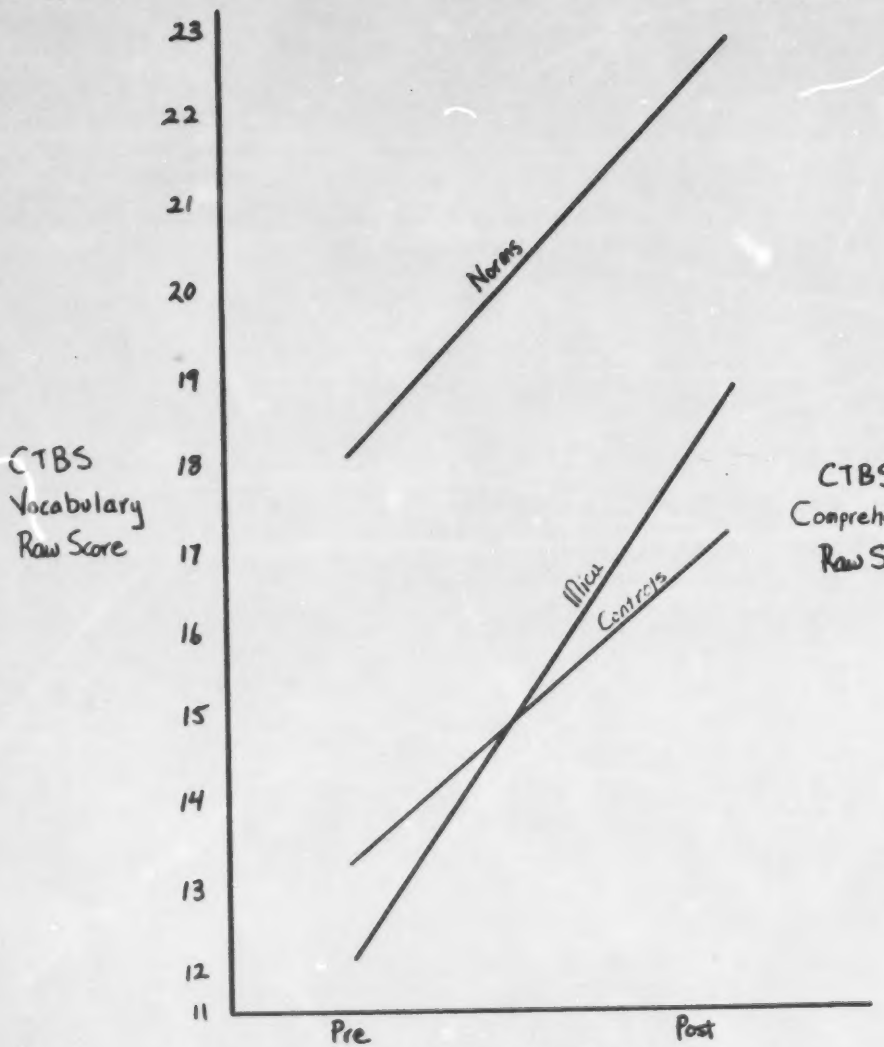
* Note: The values entered for the "norm" are raw score equivalents equal to the raw score at the 50th percentile for each subscale and total.

to mean student gains which show a mean of 12.13 in the fall, and 18.91 in the spring. This represents a gain of 6.78 in contrast to 5.00 for the norm group and 3.79 for comparison group. These results are presented graphically on Figure 21.

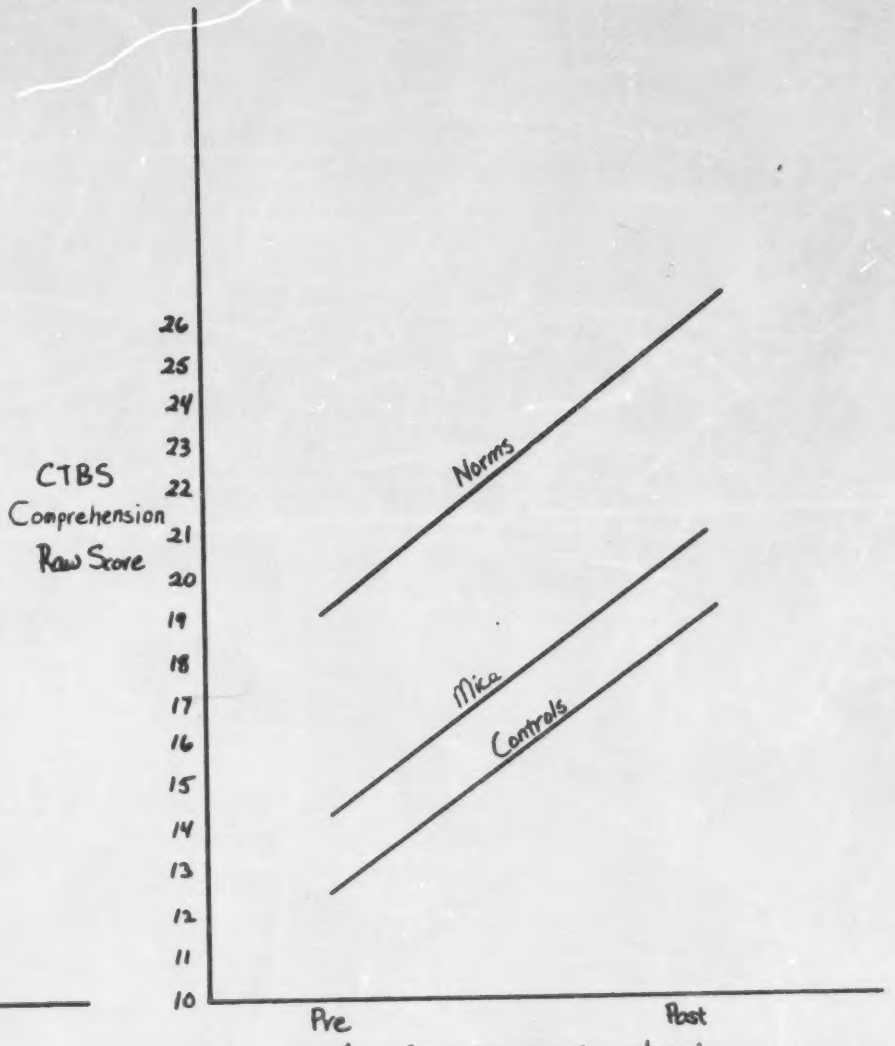
There are several comments which would seem appropriate regarding the relative gains of norm, comparison, and MICA groups. First, as can be see, pre-test scores for MICA and controls were approximately the same. Second, although both groups improved, the gain exhibited by the MICA was nearly twice that of the control or comparison group, and almost 2 points more than the norm group. An examination of the pre/post differentials between controls and MICA groups, relative to the norms, would suggest that to some extent the discrepancy for the control children was increased slightly. In other words, the MICA group seems to have reduced the achievement gap slightly, whereas the controls have slipped slightly further behind.

Figures 22 through 33 provide graphic summaries for each set of comparisons across:

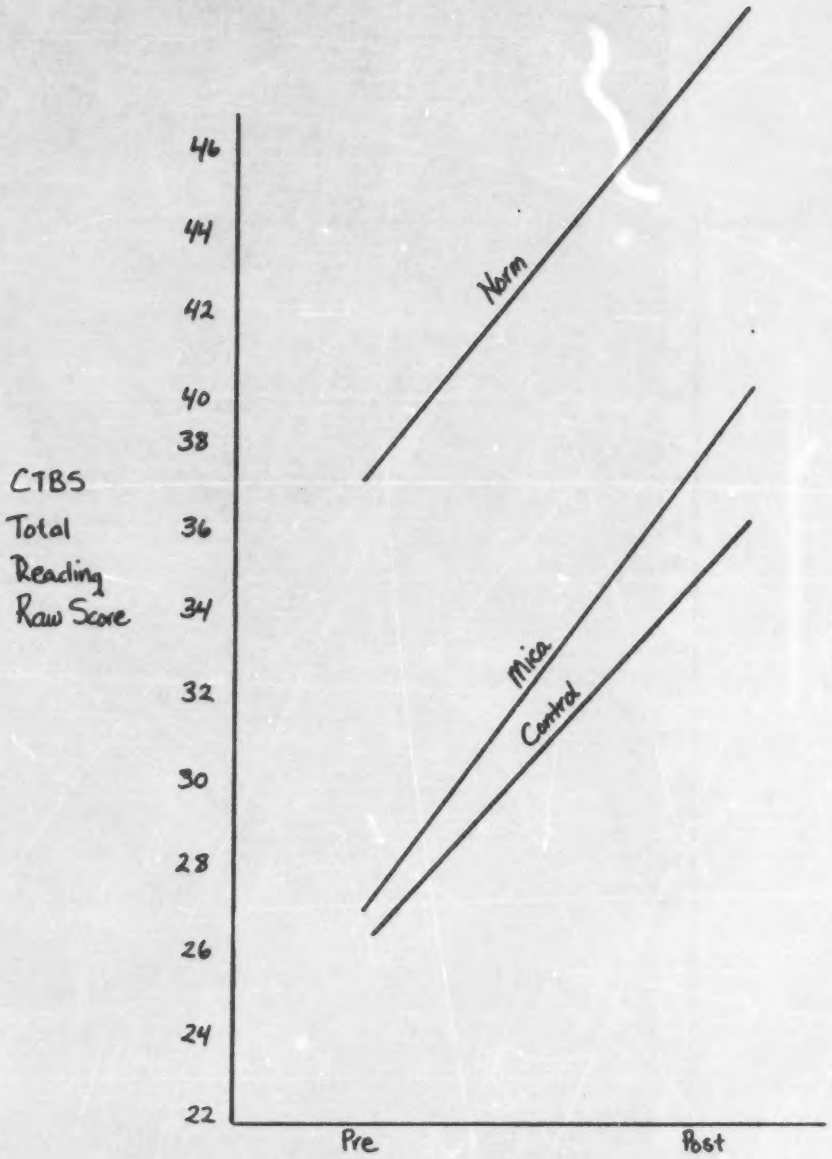
Insert Figures 21 through 33 about here



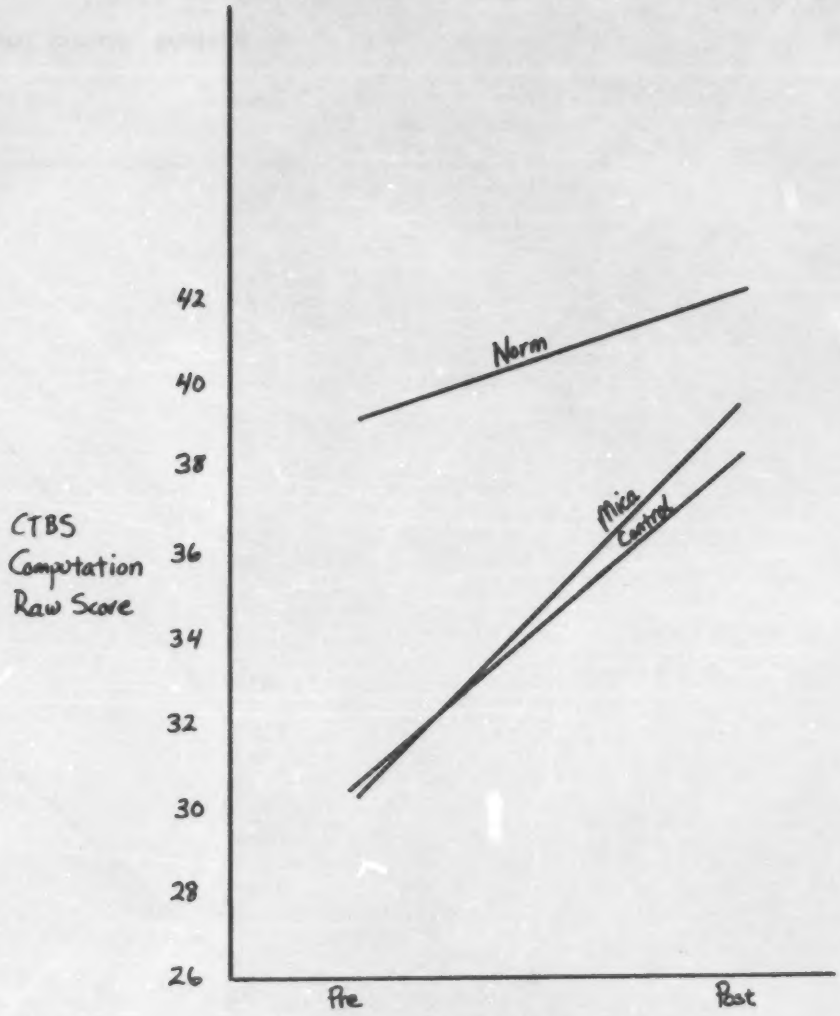
Third Grade CTBS Vocabulary
Figure 21.



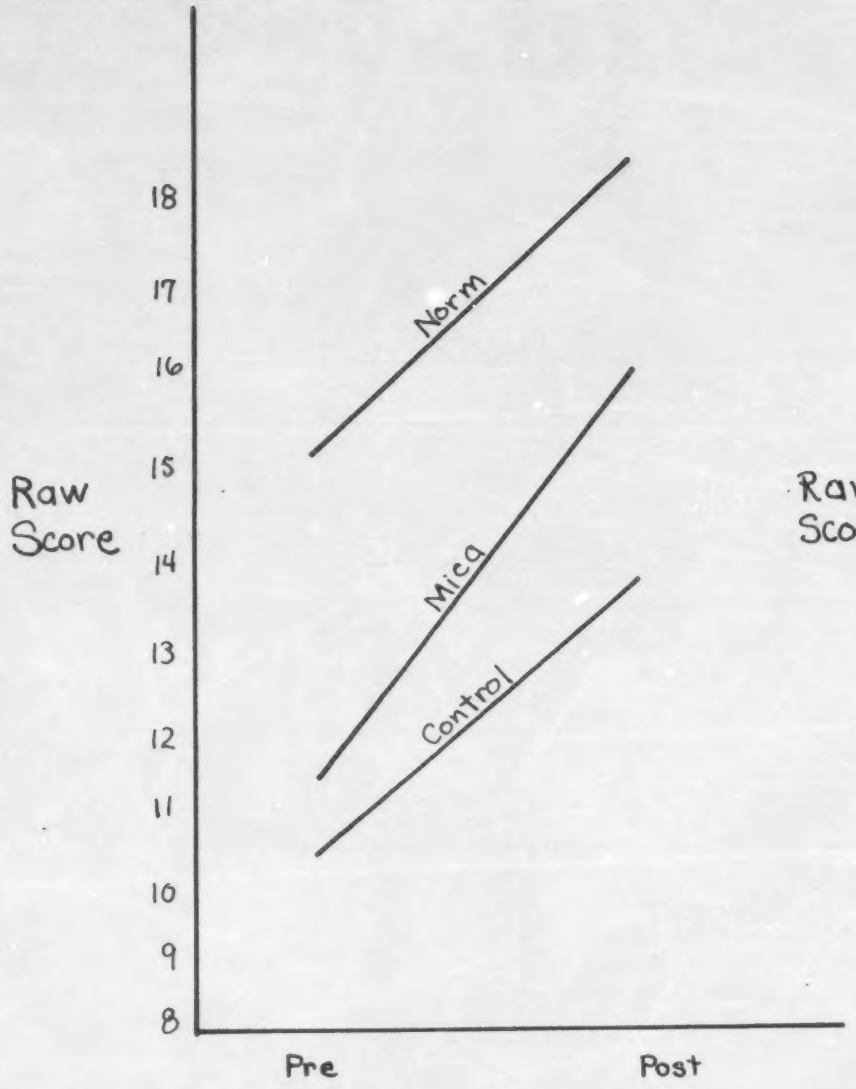
Third Grade CTBS Comprehension
Figure 22.



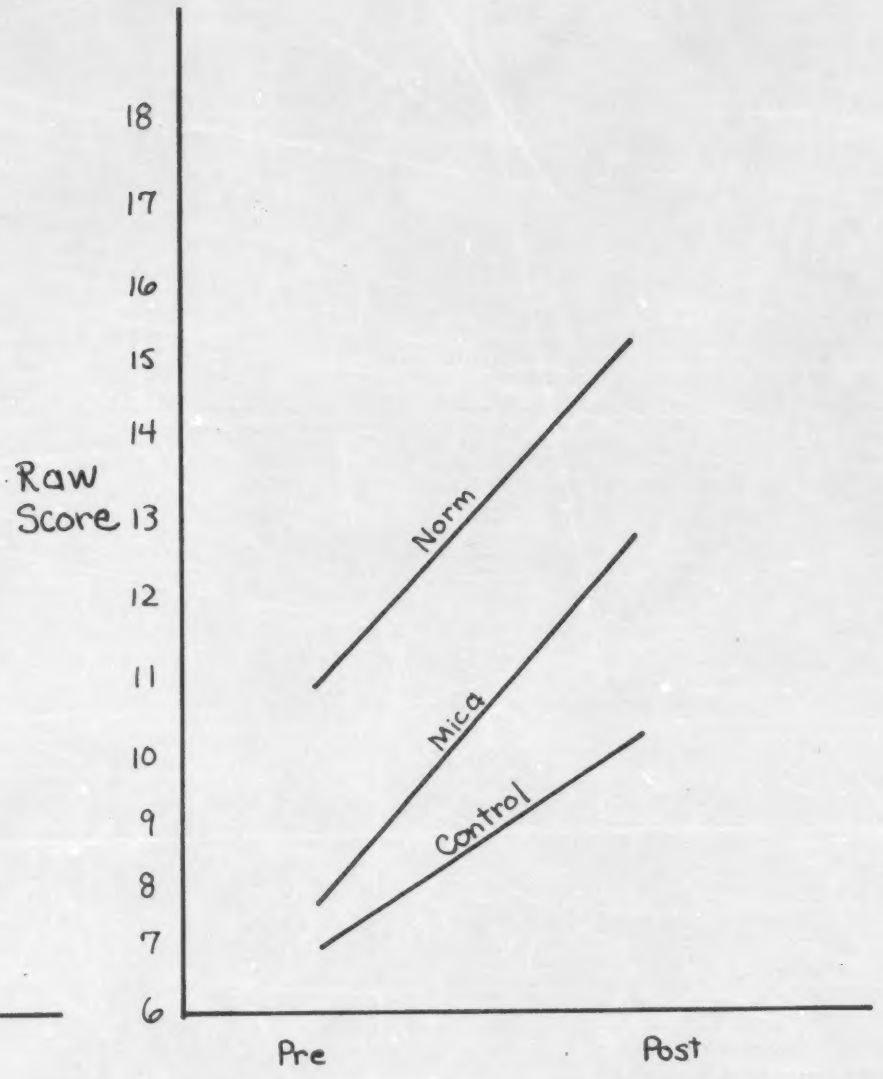
Third Grade CTBS Total Reading
Figure 23.



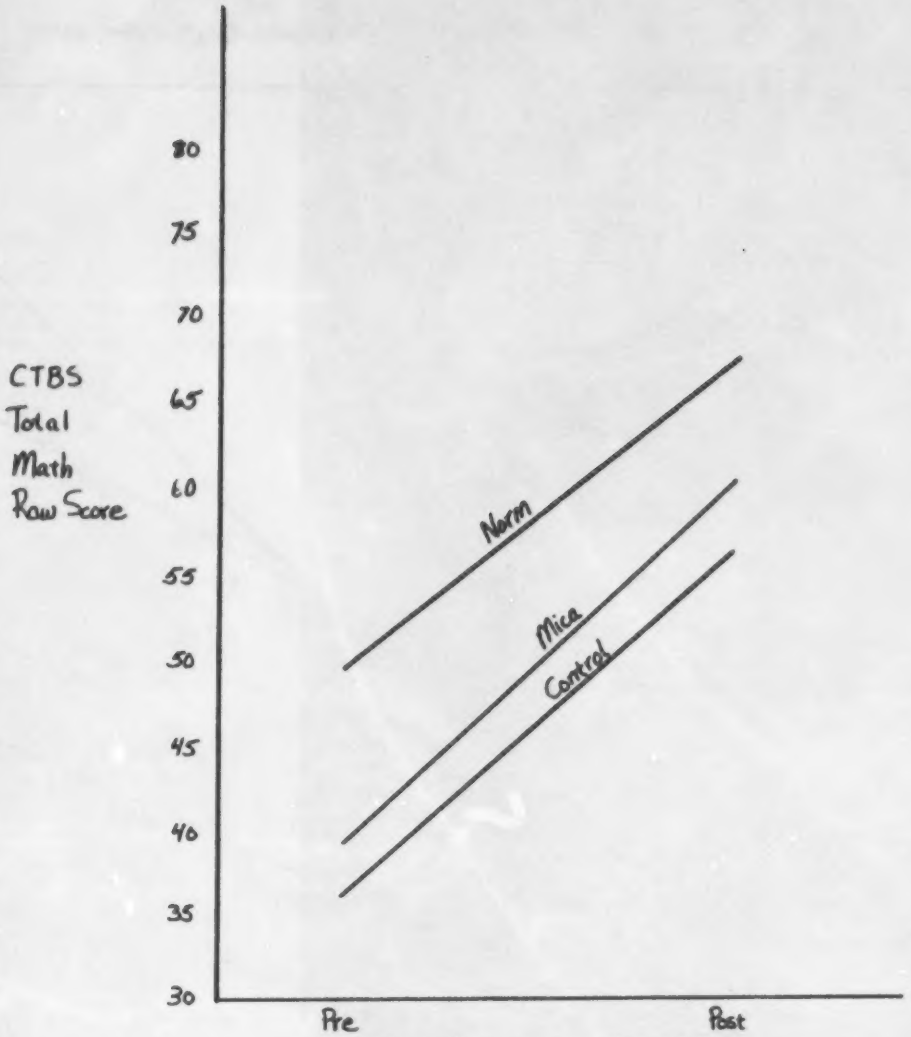
Third Grade CTBS Computation
Figure 24.



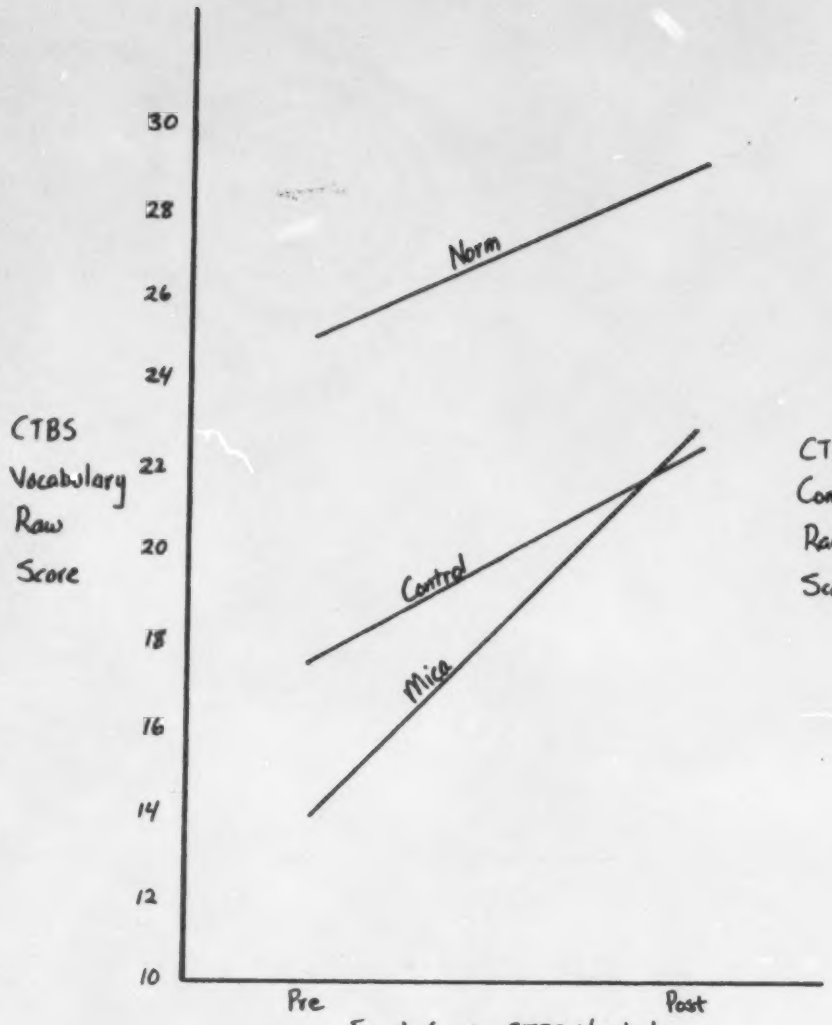
Third Grade Math Concepts
Figure 25



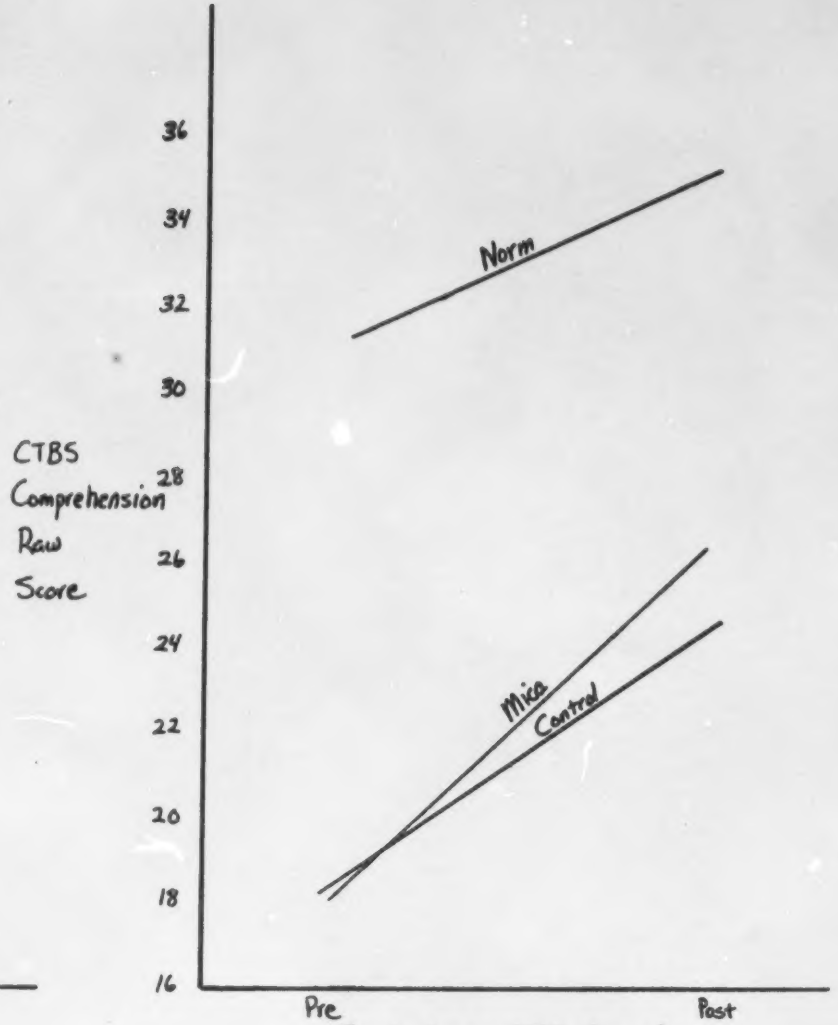
Third Grade Math Applications
Figure 26



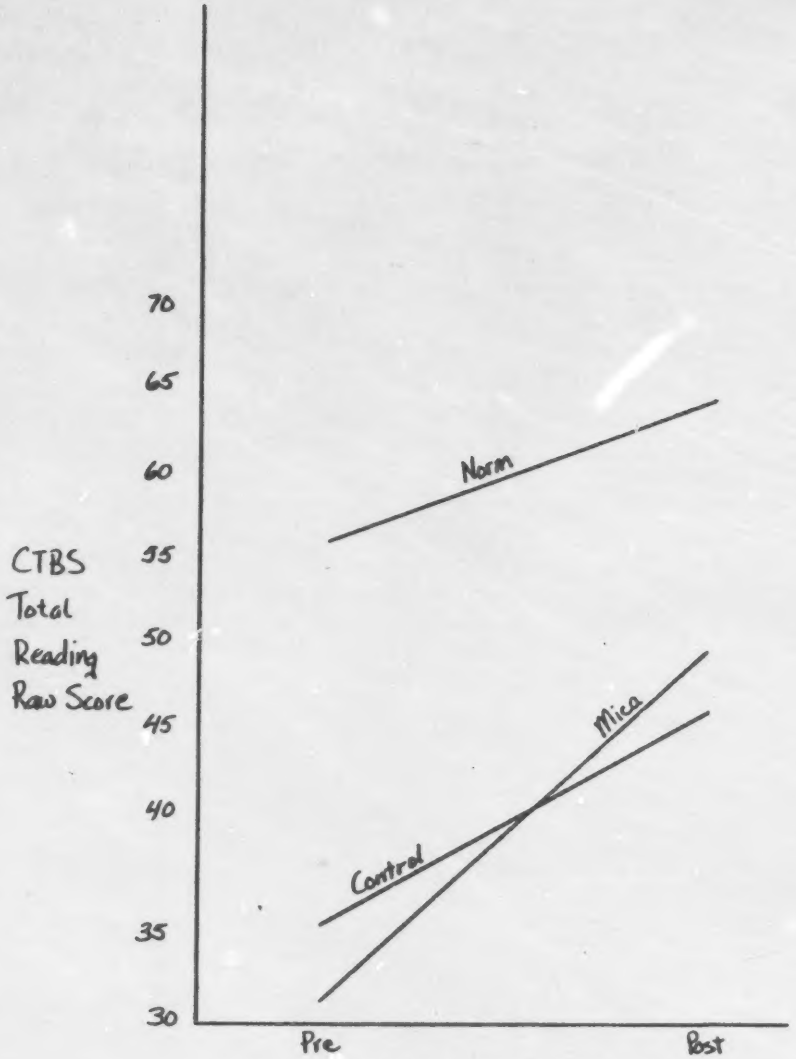
Third Grade CTBS Total Math
Figure 27.



Fourth Grade CTBS Vocabulary
Figure 28.

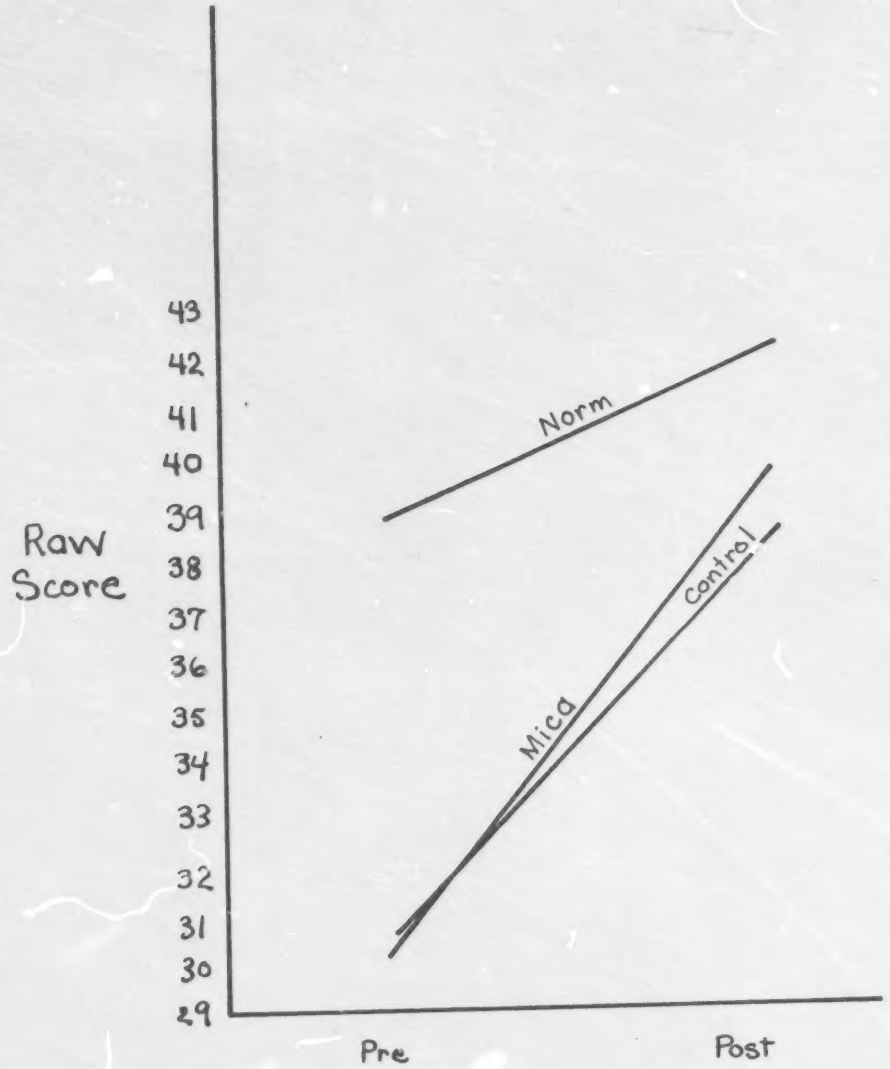


Fourth Grade CTBS Comprehension
Figure 29.

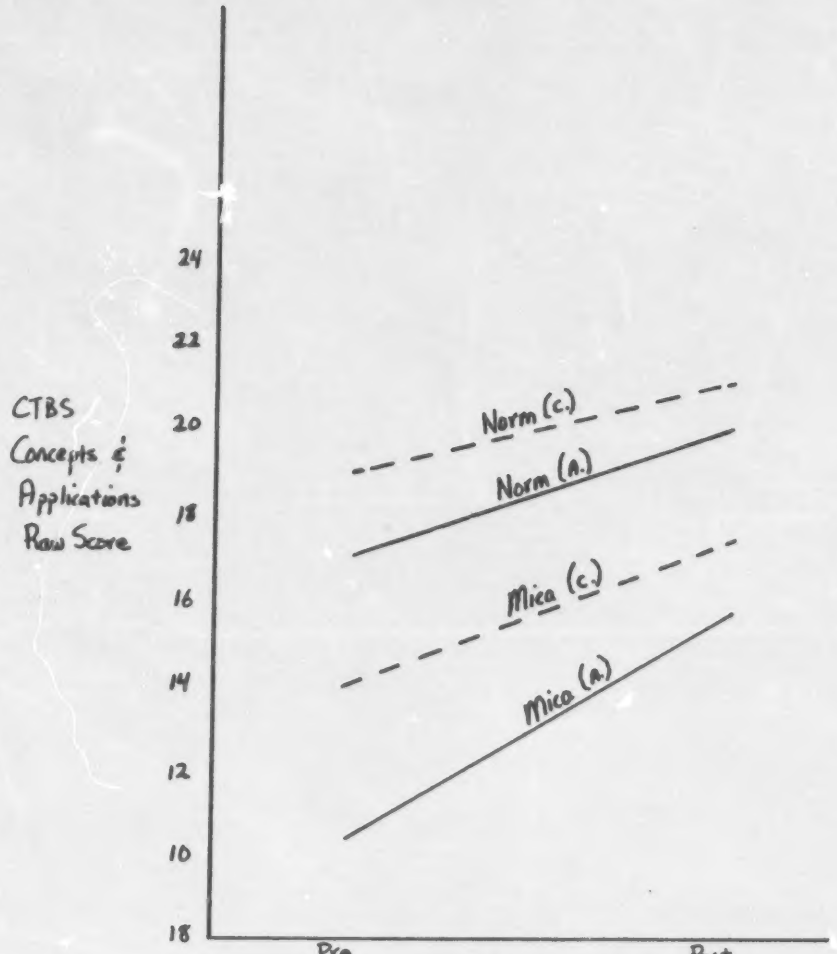


Fourth Grade CTBS Total Reading

Figure 30.

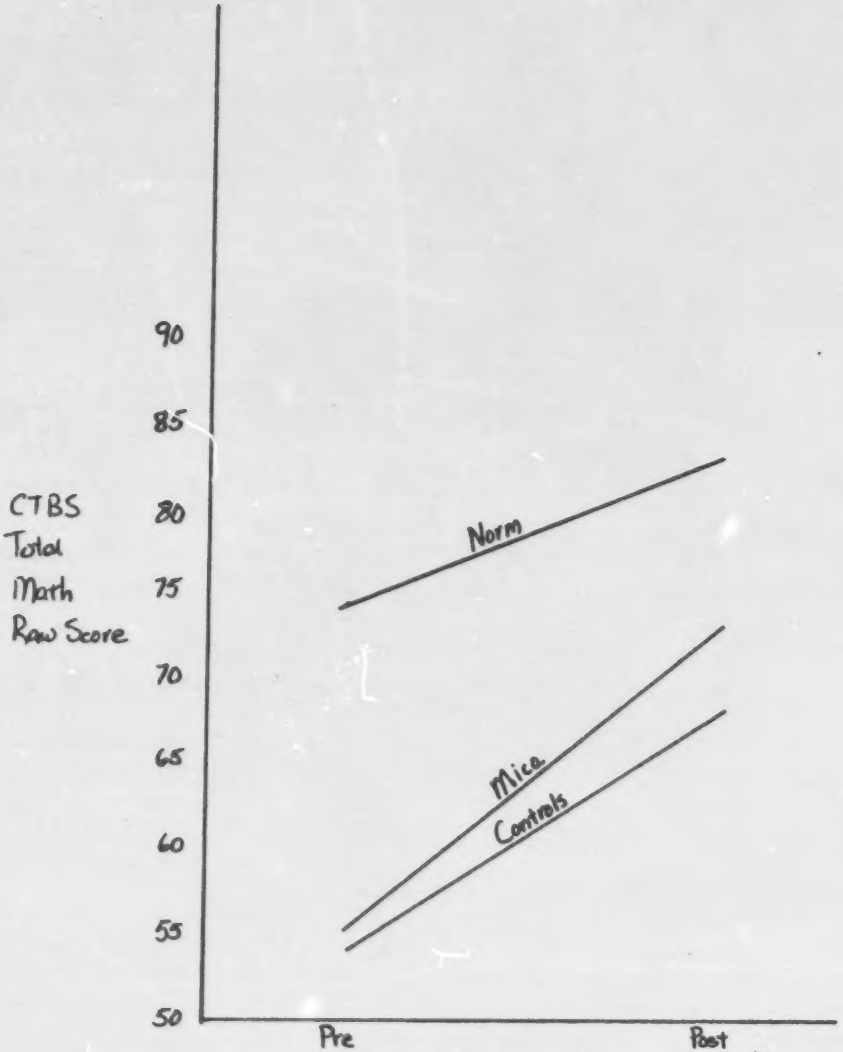


Fourth Grade CTBS Computation
Figure 31



Fourth Grade CTBS Concepts & Applications

Figure 32.



Fourth Grade CTBS Total Math
Figure 33.

	3rd Grade	Figure #
Reading:	Vocabulary	21
	Comprehension	22
	Total Score	23
Math:	Computation	24
	Concepts	25
	Applications	26
	Total Score	27
	4th Grade	
Reading:	Vocabulary	28
	Comprehension	29
	Total Score	30
Math:	Computation	31
	Concepts & Application	32
	Total Score	33

The statistical significance of these differences were examined through the use of ANOVA techniques in which the performance of the two MICA groups was compared to that of the comparison group. The results of these analyses are summarized on Table 8. It should be borne in mind that, in reviewing the results provided on Table 8, results are presented for each grade separately due to the use of different CTBS test forms for the third and fourth grade. Each of the following analyses were based on a three (Intensive, Economic, and Controls) by two (pre vs. post) design.

Examination of Table 8 reveals that, with respect to reading, there were no significant mean differences between pre and post scores for the two MICA or comparison groups.

In all cases, however, significant F values were obtained for time. Finally, there were no significant interactions between condition and time. These results would strongly suggest that both MICA and Controls significantly improved between pre and post-tests. This finding was the same for both third and fourth grade students, and would seem to imply that these gains were probably more the results of participation in the bilingual program rather than the MICA program, since both were participating in the bilingual program. In other words, it would appear that participation in the MICA program did not improve scores in reading over and above that which resulted from participation in the bilingual program. On a more positive note, one might also argue that, conversely, added participation in the MICA program did not detract from the gains produced by the bilingual program; nothing was lost by learning some of the skills and content embodied in the curriculum.

The results of the comparison of MICA and control students on math computation reveal no statistical significant difference. Unfortunately, data on CTBS concepts and applications subscales were not available for the fourth grade control subjects. With respect to third grade students for whom data were available, results which show significant effects between the three groups were found for both CTBS concepts and applications subtests. The direction and extent of these differences are shown graphically on Figures 25 and 26.

Insert Table 8 about here

ANOVA SUMMARY TABLE 8

CONDITION (MICA X CONTROLS)

X

PRE/POST TEST

VARIABLE		Grade 3		Grade 4	
VOCABULARY		F	Sig	F	Sig
	Condition	0.636	.530	2.451	.118
	Time	100.750	.000	64.980	.000
	Condition x Time	.200	.819	.710	.400
COMPREHENSION					
	Condition	.381	.683	.311	.578
	Time	75.513	.000	50.586	.000
	Condition x Time	.229	.795	.006	.936
READING TOTAL					
	Condition	0.426	.654	.172	.678
	Time	97.265	.000	63.633	.000
	Condition x Time	.013	.987	.199	.656
		MATH			
COMPUTATION					
	Condition	2.195	.112	.120	.729
	Time	478.171	.000	62.283	.000
	Condition x Time	.068	.935	.003	.955
CONCEPTS					
	Condition	5.808	.003	.536*	.465
	Time	87.78	.000	6.460	.011
	Condition x Time	3.396	.034	.015	.901
APPLICATION					
	Condition	3.288	.038	.345*	.558
	Time	104.61	.000	13.345	.000
	Condition x Time	3.534	.030	.263	.608
MATH TOTAL					
	Condition	3.373	.035	1.553	.214
	Time	301.289	.000	22.089	.000
	Condition x Time	1.434	.239	.094	.759

* includes MICA subjects only. Data for controls not available for this analysis.

In the final set of comparisons, the results of the two-way ANOVA on math total score revealed significant differences for the third grade (P = .035), but not for fourth grade students (P = .214). In light of the above, it would appear that MICA positively influenced the ability of participating students to set up problems and understand mathematical concepts; precisely those skills thought to be most representative of "think skills" in that their solutions depend least on rote formulas (Moser, 1979). As a last comment, it is important to note that most of the students in the MICA program were in the third grade (approximately 85 per cent) and that the findings relative to the fourth grade apply to only 39 students.

In order to further examine the above findings, a second series of analyses was conducted which involved a comparison of the relative gains for MICA and control students. This second series of analyses is described below. Two distributions of scores were produced by subtracting the fall norm from each pre-test score for MICA and control subjects. The same process was used to generate two distributions using the spring norm subtracted from the post-test scores obtained by MICA and control students. In this way, it thus becomes possible to test for the statistical significance of the extent to which there is a greater reduction in the discrepancy between MICA vs. norm scores as opposed to control vs. norm. The results of this series of analyses are provided below in Tables 9 and 10.

Insert Tables 9 and 10 about here

TABLE 9

Summary of T-Test Results MICA Versus Control
Gain Scores for Third Grade

	Number Of Cases	Mean Gain	Standard Deviation	T Value	Degrees Of Freedom	2-Tail Problem
		VOCABULARY				
MICA	137	6.79	5.28	4.01	233.24	.000
CONTROL	118	3.90	6.09			
		COMPREHENSION				
MICA	134	6.37	7.13	0.06	233.57	.955
CONTROL	116	6.32	7.92			
		TOTAL READING				
MICA	133	13.15	10.24	2.07	229.90	.040
CONTROL	116	10.24	11.75			
		COMPUTATION				
MICA	136	13.80	9.34	0.03	249.11	.973
CONTROL	118	13.76	9.02			
		CONCEPTS				
MICA	130	4.05	4.73	1.70	236.51	.090
CONTROL	110	3.13	3.69			
		APPLICATION				
MICA	117	4.47	5.50	1.43	216.25	.154
CONTROL	102	3.50	4.52			
		TOTAL MATH				
MICA	116	22.34	15.09	3.22	212.61	.011
CONTROL		20.46	12.33			

TABLE 10

Summary of T-Test Results MICA Versus Control
Gain Scores for Fourth Grade

	Number Of Cases	Mean Gain	Standard Deviation	T Value	Degrees of Freedom	2-Tail Problem
		VOCABULARY				
MICA	39	8.97	7.40	3.07	51.32	0.003
CONTROL	184	5.04	6.53			
		COMPREHENSION				
MICA	39	8.23	6.36	1.91	62.58	0.061
CONTROL	182	6.01	7.46			
		TOTAL READING				
MICA	39	17.13	11.51	3.04	55.06	0.004
CONTROL	182	10.96	11.37			
		COMPUTATION				
MICA	39	9.08	10.27	0.95	55.38	0.346
CONTROL	183	7.35	10.26			
		TOTAL MATH				
MICA	37	17.67	14.43	1.68	51.27	0.100
CONTROL	182	13.32	14.24			

Note that results are provided separately for 3rd and 4th grades.

In reviewing the data presented on Tables 9 and 10, the scores refer to the absolute gains experienced by MICA and control subjects relative to fall and spring norms. The test of significance, therefore, compares relative gain scores as opposed to pre and post raw scores as were compared in the foregoing ANOVA. It should also be noted that for the present purpose MICA intensive and economic groups were collapsed.

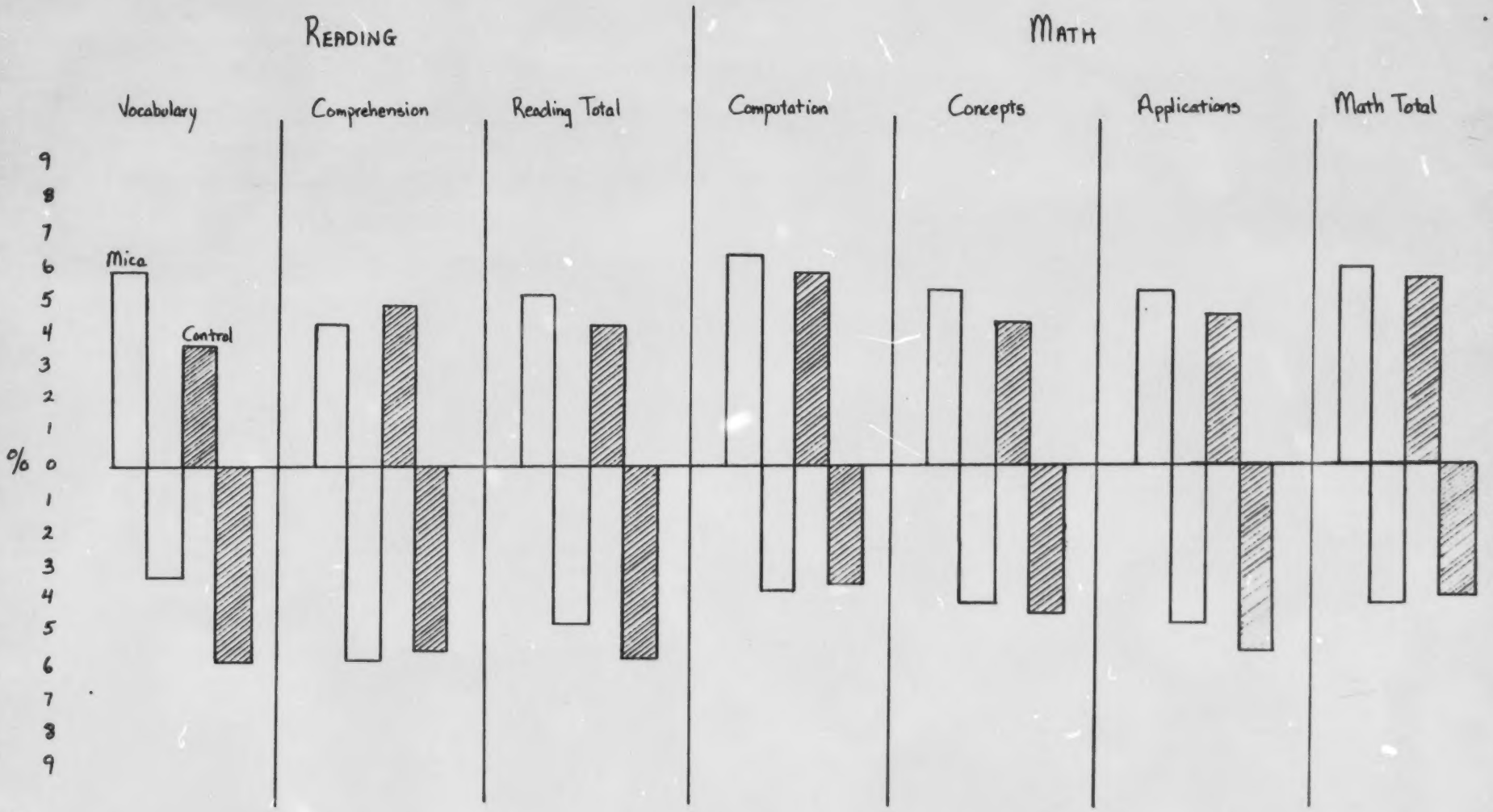
The results provided on Table 9 for the third grade show significantly larger gains for the MICA group in: vocabulary, total reading, math concepts, and total math scores. With respect to students in the fourth grade, significantly larger gains were found for the MICA group on: reading vocabulary, comprehension, total reading, and total math. It is of some interest to note that in not one of the 12 analyses did the control group experience a greater reduction in their relative achievement gap than did the MICA group.

The above analyses, based on mean gain comparisons, would indicate a stronger effect for students in the MICA program and those participating in the regular bilingual programs, even though both show positive post-score gains over pre-test scores. There is, however, a question as to the consistency of gains across children. Did the programs have the same positive effect across all children in the sample, regardless

of other considerations, such as prior achievement, language background and so on. The following provides an analysis of this question by calculating the percentage of children whose scores have moved up, down, or remained unchanged relative to the norm. Figures 34 and 35 provide a graphic illustration of this type of analysis across MICA and control groups. In reviewing these results, only those percentages involving change are presented. Thus, for example, 57 per cent of the MICA children moved up in standing relative to the norm for vocabulary, in contrast to 35 per cent for the control group. Conversely, 32 per cent of the MICA children had lower scores on the post-test relative to the norm, in contrast to 58 per cent for the control group. By simple addition, the percentage of children whose standing remained unchanged was 10 and 7 per cent respectively.

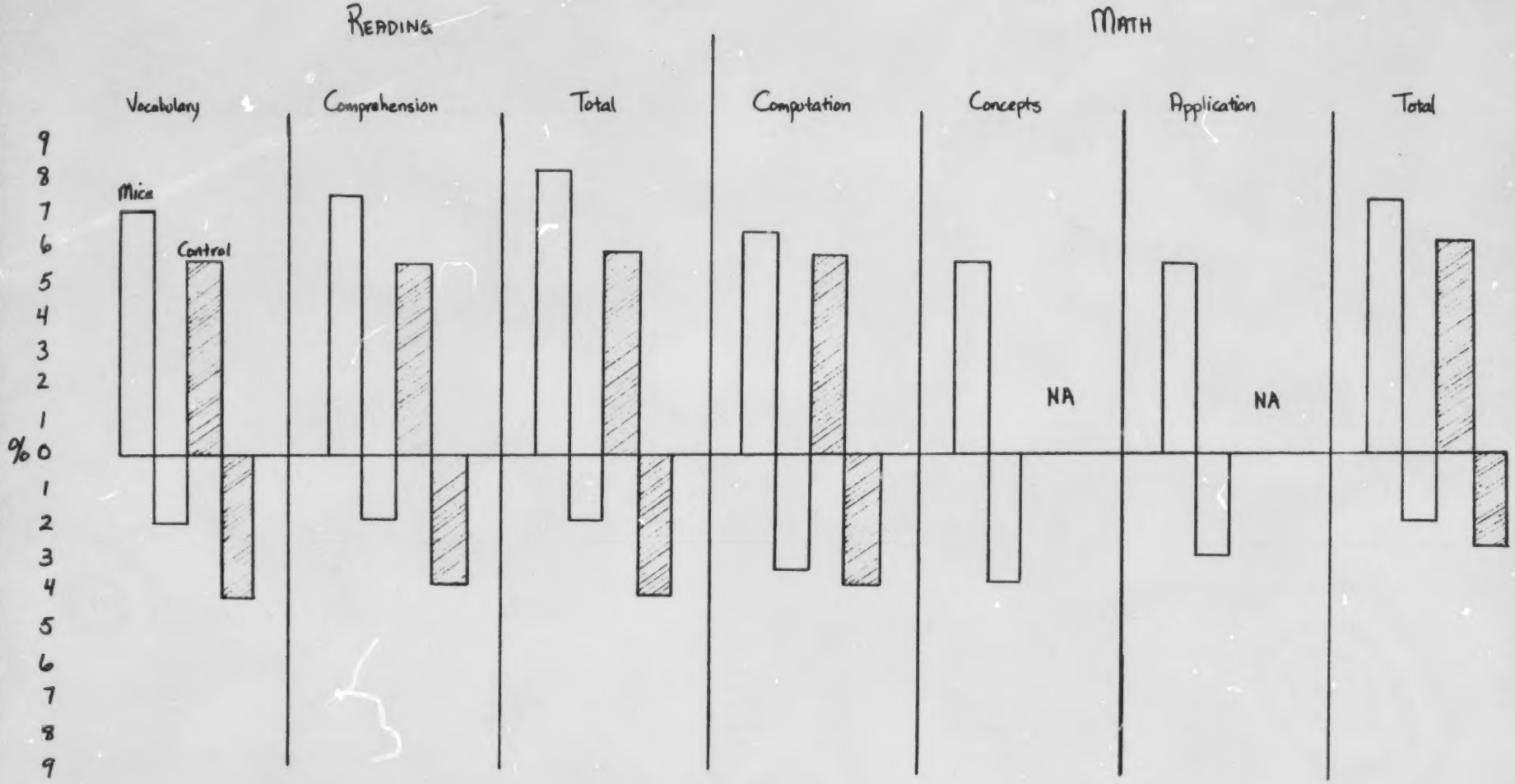
Insert Figures 34 and 35 about here

Finally, in reviewing these data it is important to bear in mind that the percentages refer to the number of children who gained at least as much as was expected by the norm. A student who "gained" would therefore have to have increased their score between pre and post-tests more than that represented by the fall/spring gains in the publisher's 50th percentile raw score norm. Viewed in this way, it would be possible for a student to have gained between pre and post-tests, but lost ground relative to their standing with the norm. In this sense, the



Third Grade % of Students Improving/Dropping

Figure 34.



Fourth Grade % of Students Improving/Dropping

Figure 35.

present analysis bears on the extent to which children moved up or down in their standing relative to the norm, and not to whether or not they gained or lost in an absolute sense. The data presented in the previous sections would seem to suggest that the percentage of students who received lower scores in the post-test compared to the pre-test would be quite small. In fact, the only identifiable group who seems to have "lost" would be the older (Group #4) students who constituted no more than about 6% of the total MICA population. And even this group did not seem to "lose" consistently (i.e., across all tests), showing substantial "gains" on both CTBS math and CCS.

A cursory review of Figures 34 and 35 shows a greater percentage of control students advancing in relation to the norm as in the case of third grade reading comprehension. In all other instances, the percentage of students gaining, over those losing, was greater for MICA students. The statistical significance of these differences was tested through the use of the Willoxon match pairs signed ranks test, where the number of children gaining relative to the norm was compared between MICA and control students. Results summarized on Tables 11 and 12 indicate that for MICA students there was a statistically greater percentage of students gaining, in comparison to those dropping, in ten out of the fourteen analyses. For the controls, significant gains were found in seven out of twelve analyses, where $P<.05$ is used as a criterion

Insert Table 11 and 12 about here

TABLE 11

Summary of Willoxon Pre/Post Rank Comparisons
For MICA & Controls
3rd Grade Reading

MICA

VOCABULARY

Cases	Ties	44-Ranks Mean	79+Ranks Mean	Z	2-Tailed P
137	14	52.25	67.43	-3.821	0.000

COMPREHENSION

Cases	Ties	73-Ranks Mean	54+Ranks Mean	Z	2-Tailed P
134	7	63.73	64.36	-1.416	0.157

TOTAL READING

Cases	Ties	59-Ranks Mean	67+Ranks Mean	Z	2-Tailed P
133	7	61.75	65.04	-0.870	0.384

MATH

COMPUTATION

Cases	Ties	49-Ranks Mean	84+Ranks Mean	Z	2-Tailed P
136	3	59.53	71.36	-3.455	0.001

CONCEPTS

Cases	Ties	49-Ranks Mean	67+Ranks Mean	Z	2-Tailed P
130	14	52.20	63.10	-2.300	0.021

APPLICATIONS

Cases	Ties	53-Ranks Mean	59+Ranks Mean	Z	2-Tailed P
117	5	54.76	58.06	-0.759	0.448

TOTAL MATH

Cases	Ties	46-Ranks Mean	68+Ranks Mean	Z	2-Tailed P
116	2	52.17	61.10	-2.481	0.013

CONTROLS

VOCABULARY

Cases	Ties	68-Ranks Mean	41+Ranks Mean	Z	2-Tailed P
118	9	54.97	55.05	-2.239	0.025

COMPREHENSION

Cases	Ties	61-Ranks Mean	46+Ranks Mean	Z	2-Tailed P
116	9	53.78	54.29	-1.217	0.224

TOTAL READING

Cases	Ties	65-Ranks Mean	48+Ranks Mean	Z	2-Tailed P
116	3	59.51	53.60	-1.855	0.064

COMPUTATION

Cases	Ties	40-Ranks Mean	70+Ranks Mean	Z	2-Tailed P
118	8	49.61	58.86	-3.185	0.001

CONCEPTS

Cases	Ties	46-Ranks Mean	46+Ranks Mean	Z	2-Tailed P
110	18	43.98	49.02	-0.452	0.651

APPLICATIONS

Cases	Ties	54-Ranks Mean	45+Ranks Mean	Z	2-Tailed P
102	3	52.73	46.72	-1.300	0.194

TOTAL MATH

Cases	Ties	39-Ranks Mean	56+Ranks Mean	Z	2-Tailed P
99	4	46.09	49.33	-1.791	0.073

Summary of Willoxon Pre/Post Rank Comparisons For MICA & Controls 4th Grade

Table 12

MICA

VOCABULARY

Cases	Ties	8-Ranks Mean	27+Ranks Mean	Z	2-Tailed P
39	4	12.06	19.76	-3.579	0.000

COMPREHENSION

Cases	Ties	7-Ranks Mean	30+Ranks Mean	Z	2-Tailed P
39	2	13.07	20.38	-3.922	0.000

TOTAL READING

Cases	Ties	7-Ranks Mean	32+Ranks Mean	Z	2-Tailed P
39	0	12.00	21.75	-4.270	0.000

MATH

COMPUTATION

Cases	Ties	12-Ranks Mean	25+Ranks Mean	Z	2-Tailed P
39	2	12.17	22.28	-3.100	0.002

APPLICATION

Cases	Ties	11-Ranks Mean	21+Ranks Mean	Z	2-Tailed P
37	5	14.68	17.45	-1.917	

CONCEPTS

Cases	Ties	14-Ranks Mean	28+Ranks Mean	Z	2-Tailed P
39	3	16.82	19.57	-1.532	0.126

TOTAL MATH

Cases	Ties	7-Ranks Mean	28+Ranks Mean	Z	2-Tailed P
37	2	14.07	18.98	-3.546	0.000

CONTROLS

VOCABULARY

Cases	Ties	73-Ranks Mean	103+Ranks Mean	Z	2-Tailed P
184	8	84.71	91.18	-2.370	0.018

COMPREHENSION

Cases	Ties	69-Ranks Mean	102+Ranks Mean	Z	2-Tailed P
182	11	76.01	92.76	-3.252	0.001

TOTAL READING

Cases	Ties	72-Ranks Mean	107+Ranks Mean	Z	2-Tailed P
182	3	79.78	96.88	-3.329	0.001

MATH

COMPUTATION

Cases	Ties	66-Ranks Mean	106+Ranks Mean	Z	2-Tailed P
183	11	60.44	102.73	-5.275	0.000

APPLICATION

Cases	Ties	163-Ranks Mean	15+Ranks Mean	Z	2-Tailed P
0	-178	0.0	0.0	0.0	1.000

CONCEPTS

Cases	Ties	163-Ranks Mean	15+Ranks Mean	Z	2-Tailed P
183	5	94.39	36.33	-10.779	0.000

TOTAL MATH

Cases	Ties	61-Ranks Mean	111+Ranks Mean	Z	2-Tailed P
182	10	66.46	97.51	-5.176	0.000

for determining significance. Thus, for third grade MICA students, the percentage of students gaining statistically outnumbers those dropping for vocabulary, math computation, concepts, and total math. Gaining third grade control students, on the other hand, outnumbered those declining in relation to the norm, approached statistical significance in the case of total reading (P = .064) and math (P = .073) scores.

For fourth grade MICA students, the number of students gaining in standing relative to the norm over those losing in standing was significantly greater in six out of seven of the analyses conducted. Results for control students show gaining students significantly outnumbered losers in five of the analyses conducted. Unfortunately, data were not available for the concepts and applications subtests for control students. Hence, it was not possible to compare MICA and controls on these subtests.

In summary, it would appear that the number of students gaining in status relative to the norm was consistently greater than the number losing in status for both MICA and control students. To a limited extent results slightly favored MICA over control students. This was particularly true in the case of the third grade. Fourth grade results were somewhat more difficult to interpret due to the small number of MICA students in the sample (N = 39) and because control group data were not available for all subscales. Finally, results would seem to indicate that, for the MICA students, positive

effects were fairly consistent across the various reading and math subscales. This would indicate a breadth of program effect across the different types of activities which go to make up the CTBS, and that positive gains in total scores are not attributable to increases in just one type of activity, such as computation.

These results would indicate that while the MICA program seemed to have a significant impact in performance on almost all of the dependent measures, the results of the Willoxon test would also indicate that the positive results are not necessarily consistent across all children. In other words, the program may not have been uniformly effective for all children. To some extent, this question was addressed in a previous section where age group differences were considered. A further important question, therefore, becomes whether or not there were other children for whom the program was not uniformly effective and whether or not these students are in some way identifiable with respect to their characteristics, such as prior achievement, language, social/academic status and so on.

MICA vs. "Problem" subgroup. An attempt was made to address this issue. A subsample of children was drawn from the total population and their performance was compared with the total group. Teachers in each of the nine schools were asked to identify 4 to 6 children who were "likely to have difficulty in school." Because the definition was intentionally

vague, teachers identified "problem" children in a variety of ways. Thus, for example, children were identified on the basis of learning disabilities, behavior problems, language retardation and so on. The common factor across all children in this subpopulation, nevertheless, remained the same. They were seen as children who were most likely to experience failure. In effect, these were the children for whom the teachers had lower expectations. Results based on pre/post comparisons between "problem" and MICA students will be briefly described below. Insert Table 13 about here

The data provided on Table 13 presents pre and post-test means and SD's for both "problem" and MICA students on each of the important dependent measures. The first and perhaps most salient features shown in Table 13 are the consistently lower scores obtained by the "problem" group. It would, therefore, appear that what we have here is a low-achieving group. The question becomes whether or not experience in the MICA program had as positive effect on the performance of the "problem" child, as it did on MICA children in general. An examination of the pre/post curves for "problem" and MICA students shows these results. In reviewing Table 13, it should be noted that means and SD's are based on both subgroups exclusive of one another. Thus, in calculating the scores for the MICA students, "problem" students were removed. Since problem children, on the average, tended to have lower scores, this process would have the net effect of increasing or

Table 13

$\bar{X}$; SD's and Pre/Post Gain Scores for "Problem" and MICA Subgroups on CCS, CTBS & MINI Tests*

		PRE		POST		
		$\bar{X}$	SD	$\bar{X}$	SD	Gain
CCS:	MICA N= (200)	20.1	5.8	24.1	5.1	4.0
	PROBLEM N= (43)	17.8	6.1	21.7	6.3	3.9
ENGLISH LAS:	MICA	70.3	19.7	75.3	19.4	5.0
	PROBLEM	60.3	21.1	66.5	23.4	6.2
READING:	MICA	30.0	17.7	42.1	20.2	12.1
	PROBLEM	17.5 (34)	12.1	27.8	15.7	10.3
MATH:	MICA	44.1	18.4	63.4	19.9	19.3
	PROBLEM	31.3	12.7	46.9	17.4	15.6
MINI:	MICA	49.9	12.2	59.5	13.4	9.6
	PROBLEM	44.7	9.8	54.8	11.6	10.7

* N.B. The statistical significance of these scores was not tested because of a number of reasons primarily related to the small number of students in the "problem" group. Because of this, it was not possible to control for grade, age, language, and a number of other variables which may have been important. As such, these analyses are purely exploratory in an effort to identify the possible "non-gaining students."

elevating MICA subgroup scores over those reported in previous results.

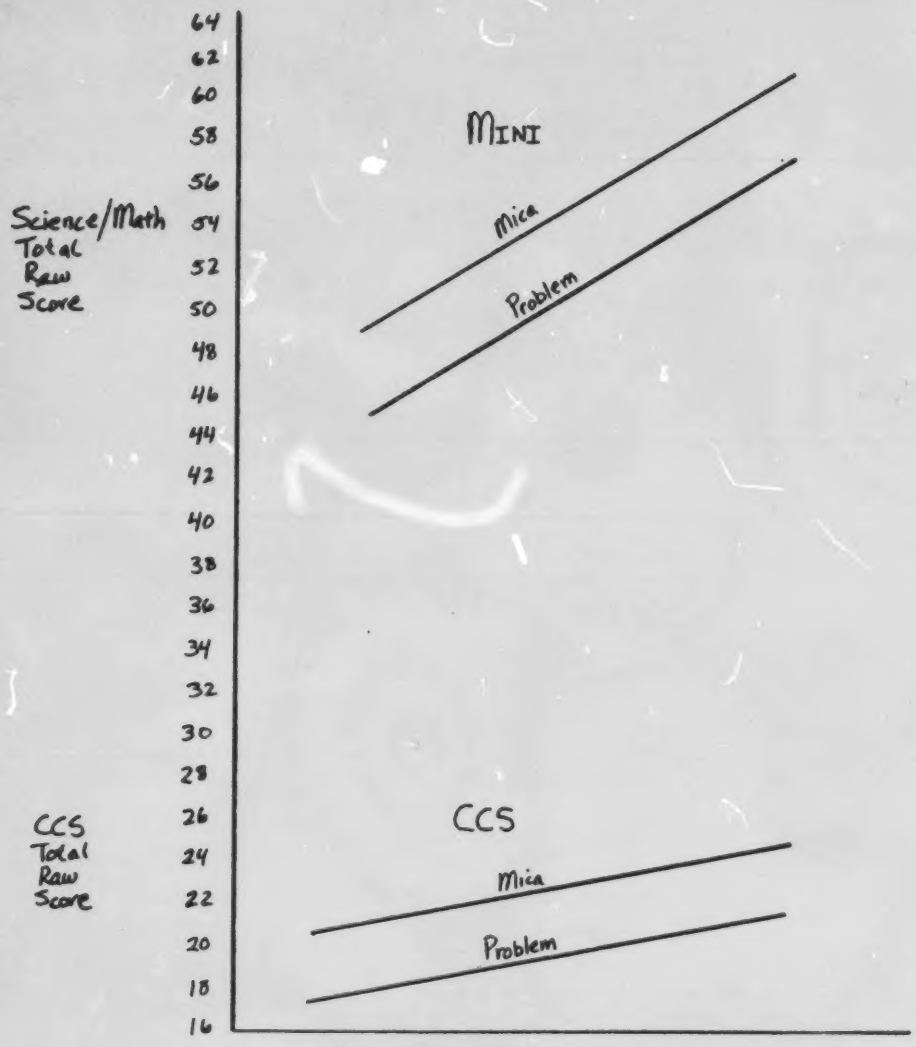
Figure 36 presents pre/post English oral language proficiency results for "problem" and MICA subgroups. As is readily apparent, MICA children received higher LAS scores on both pre and post-tests. These results also show, however, that the average gain between pre and post-tests was almost identical for the two groups. In fact, if there were any differences, they would favor the "problem" group. With respect to intellectual development, as measured by the CCS, the results depicted on Figure 37 would indicate a similar finding. Positive pre/post gains were almost identical for the two groups.

Insert Figures 36 and 37 about here

The results based on the content referenced MINI-test (see Figure 37) seem to be the same as those of the LAS and CCS where pre/post gains were virtually identical for the two groups.

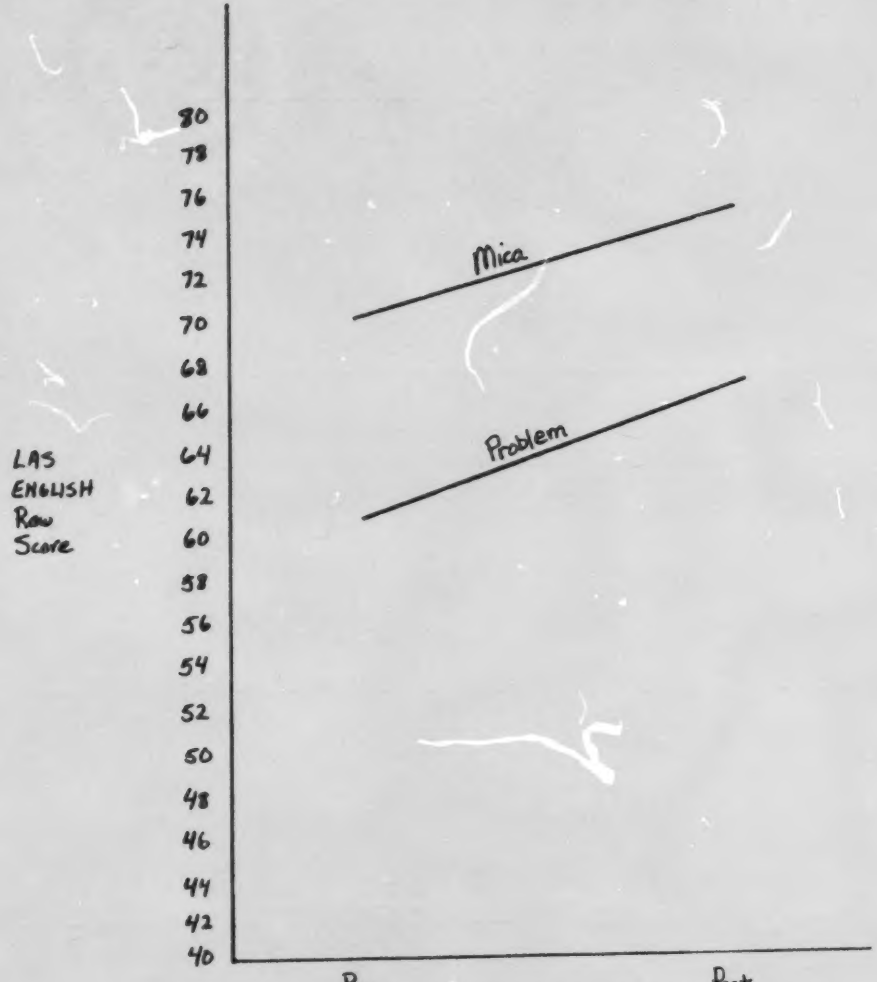
Turning to the analyses of reading and math scores (see Figure 38), a slightly different picture emerges. With respect to reading achievement, both groups showed positive gains. Both increased approximately eleven points. With respect to total math scores, the "problem" group increased slightly less than did the MICA group at large (i.e., MICA = 19.3 pt;

Insert Figure 38 about here



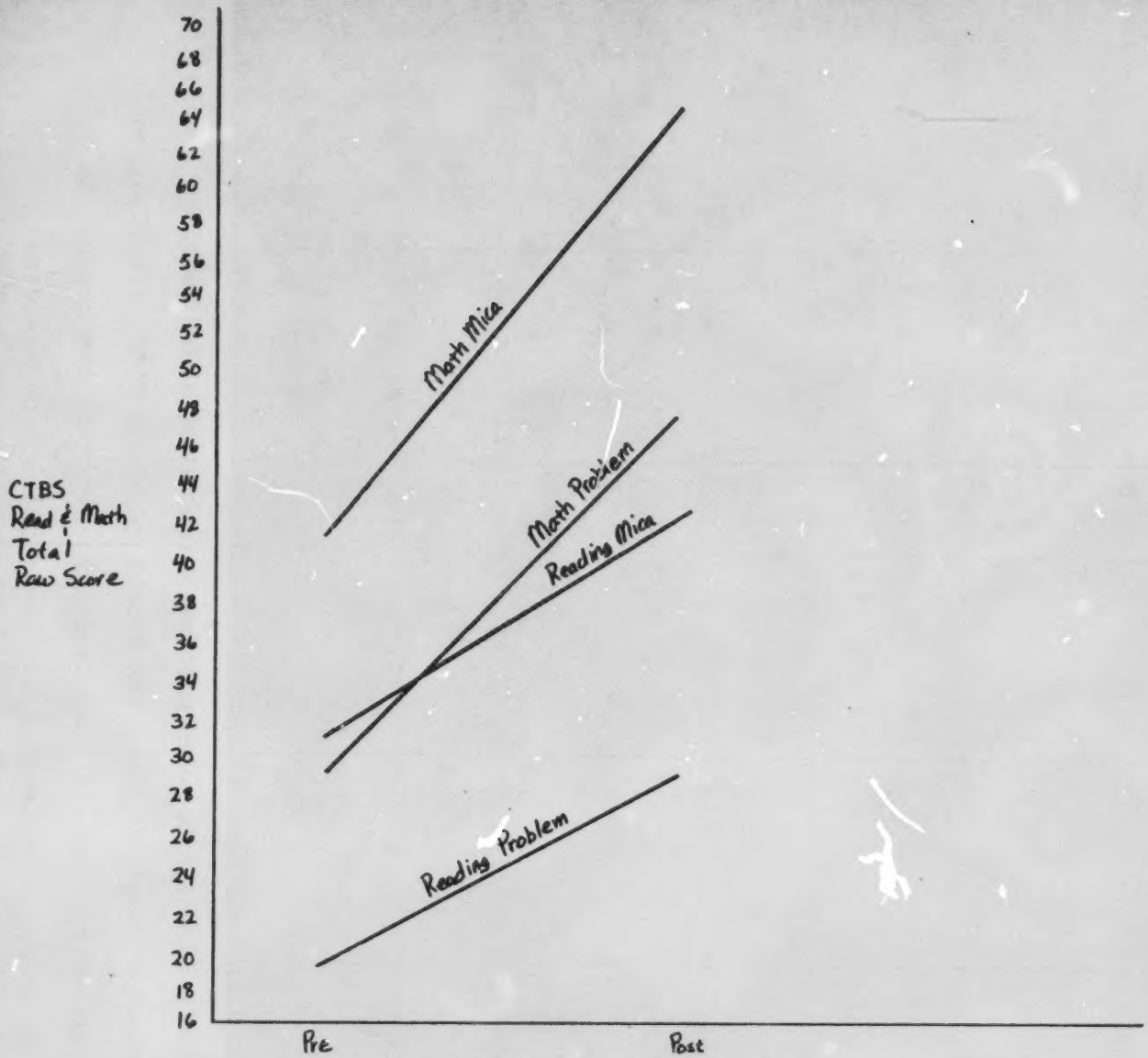
Intellectual Development & Science Math Mini-Test for Mica & "Problem" Sub-Groups

Figure 36.



English Oral Proficiency for Mica & Problem Sub-Groups

Figure 37.



CTBS Total Reading & Math for Mica & "Problem" Sub-Groups

Figure 38.

"problem" = 15.6).

To briefly summarize, it would appear that children who are identified as "most likely to experience difficulty," scored lower on the average across all of the dependent measures for both pre and post-tests. More importantly, however, results also indicate that the amount of growth between pre and post-tests was virtually the same for both groups, indicating a similarity of effect. These results would suggest that, although teachers were able to identify lower achieving children, program impact was approximately the same for them as it was for other children not so identified. Thus, the identification of a cohort of "low academic status" children did not produce a group of children who were unable to benfit from the program. If there was a subgroup of children who were systematically unable to benefit from participation, it will apparently have to be defined on the basis of other characteristics.

In the final section of this report, several analyses will be presented which are based on correlational and ANOVA techniques. In the first series, the impact of the program on the linguistic make up of the total MICA group will be examined. In the second, interrelationships between outcome variables will be briefly addressed. Consider first the extent to which MICA participation had an effect on the linguistic character of the group. As will be seen, the relevance of this final set of analyses follows from both a consideration of the objectives of the MICA program (i.e., to effect cognitive abilities) as well as from a consideration of the goals of bilingual education in general.

Program Impact on Linguistic Characteristics.

A mandated purpose of bilingual instruction, according to both state and federal guidelines, is to improve English language skills. Since, at the outset, children varied in these skills, one might speculate that linguistic characteristics may account for some of the variability in program impact. While it is not the purpose of this report to discuss the question of the interaction between linguistic and outcome variables per se, in closing, it would seem worthwhile to briefly consider the impact of the MICA program on several linguistic types. In this regard, there are two questions that would seem important.

First, to what extent did participation in the MICA program have an impact on the linguistic characteristics of the students? Second, to what extent could program outcomes be covariant with or be explained by linguistic considerations? A full consideration of these latter questions is not possible in the present context since linguistic controls were not available across the entire data set. The following, therefore, will focus on the first question. Answers to the second will have to await more controlled investigation.

In a recent series of articles, the relative scores between Spanish and English oral proficiency have been used to describe children of different linguistic characteristics (Dulay & Burt, 1980; De Avila & Duncan, 1979). Given this determination, it would also seem possible to examine the extent of change between pre and post-test scores relative to the norm, in the same way, as was done with respect to academic achievement. In the pre-

ceeding, LAS (English and Spanish oral proficiency) scores were based on a 0 to 100 scale. In the following, LAS scores were reduced to a 1 to 5 scale with a score of 1 indicating "no proficiency," and a score of 5 indicating "full proficiency." The relationship between point score and level score is provided below for both English and Spanish monolingual norms.

English/Spanish

Level	Point Score
I	54 and below
II	55 to 64
III	65 to 74
IV	75 to 84
V	85 to 100

It should be noted, in the following, that levels 4 and 5 are considered as proficient.

By reducing LAS point scores to a 1 to 5 scale, two types of analyses become possible which are important in the present context. The first type would involve a comparison of level scores between pre and post-test administrators. This type of comparison would be similiar to the correlation between pre and post-test scores. However, rather than focusing on the simple correlation, it would seem more important to determine the number of students identified at each level across the two test administrations. Thus, Table 14 shows the number of students who received a level score of 1 on the English pre-test

as 30. The number who received the same score in the post-test was 14. The remaining 16 students improved. On the other

Insert Table 14 about here

hand, the number who received a score of 5 on the pre-test was 29. Of these 29, 22 also received a score of 5 on the post-test. As can be seen, the general trend was to improve. Further inspection of Table 14's diagonal shows that, with respect to English, 41.8 per cent of the scores remained unchanged, 36.7 per cent improved, and 11.8 per cent received lower scores. These results may be contrasted with those for Spanish (shown on Table 15) where 65 per cent remained unchanged, while 20.8 per cent improved, and 14.1 per cent received lower scores. The apparent discrepancy between the percentage of children remaining unchanged in English vs. Spanish is accounted for by the fact that on the Spanish test approximately 80 per cent of the students received a score of 1 on the pre-test as well as on the post-test. What this means is that students who were at the lowest level of oral proficiency in Spanish at the pre-test tended not to improve in the post-test. Children who were at the lowest level of English oral proficiency, in contrast, tended to receive higher scores in the post-test. Thus, whereas 14.2 per cent of the total population received pre-test

Insert Table 15 about here

Pre/Post Test
Breakdown for English Levels

Table 14

(post-test)

COUNT I ROW PCT I COL PCT I TOT PCT I	1	2	3	4	5	ROW TOTAL
1	14	10	4	1	1	30
	46.7	33.3	13.3	3.3	3.3	14.1
	87.5	50.0	10.5	1.5	1.4	
	6.6	4.7	1.9	0.5	0.5	
2	1	4	7	6	4	22
	4.5	18.2	31.8	27.3	18.2	10.3
	6.3	20.0	18.4	9.2	5.4	
	0.5	1.9	3.3	2.8	1.9	
3	1	3	17	19	21	61
English	1.6	4.9	27.9	31.1	34.4	28.6
Level	6.3	15.0	44.7	29.2	28.4	
(pre-test)	0.5	1.4	8.0	8.9	9.9	
4	0	3	10	32	26	71
	0.0	4.2	14.1	45.1	36.6	33.3
	0.0	15.0	26.3	49.2	35.1	
	0.0	1.4	4.7	15.0	12.2	
5	0	0	0	7	22	29
	0.0	0.0	0.0	24.1	75.9	13.6
	0.0	0.0	0.0	10.8	29.7	
	0.0	0.0	0.0	3.3	10.3	
COLUMN TOTAL	16	20	38	65	74	213
	7.5	9.4	17.8	30.5	34.7	100.0

NUMBER OF MISSING OBSERVATIONS = 94

Pre/Post Test
Breakdown for Spanish Levels

Table 15

COUNT I / ROW PCT I / COL PCT I / TOT PCT I	(post-test) 1	2	3	4	5	ROW TOTAL
Spanish Level (pre-test) 1	95	5	5	0	2	107
	88.8	4.7	4.7	0.0	1.9	50.0
	96.9	55.6	9.4	0.0	5.9	
	44.4	2.3	2.3	0.0	0.9	
2	3	2	5	0	2	12
	25.0	16.7	41.7	0.0	16.7	5.6
	3.1	22.2	9.4	0.0	5.9	
	1.4	0.9	2.3	0.0	0.9	
3	0	1	25	6	11	43
	0.0	2.3	58.1	14.0	25.6	20.1
	0.0	11.1	47.2	30.0	32.4	
	0.0	0.5	11.7	2.8	5.1	
4	0	0	8	7	9	24
	0.0	0.0	33.3	29.2	37.5	13.1
	0.0	0.0	15.1	35.0	26.5	
	0.0	0.0	3.7	3.3	4.2	
5	0	1	10	7	10	28
	0.0	3.6	35.7	25.0	35.7	13.1
	0.0	11.1	18.9	35.0	29.4	
	0.0	0.5	4.7	3.3	4.7	
COLUMN TOTAL	98	9	53	20	34	214
	45.8	4.2	24.8	9.3	15.9	100.0

NUMBER OF MISSING OBSERVATIONS = 93

scores of 1, only 6.6% received scores of 1 on the post-test.

In the same way as it is possible to examine the extent of change in each language separately, it is also possible to change, when both English and Spanish level scores are considered simultaneously, thereby obtaining an idea as to the extent of change in the relative oral proficiency of the two languages. Moreover, a simultaneous comparison of the two languages would provide a more natural appreciation of the linguistic character of the population and the extent to which the program has had an effect on that character. Unfortunately, however, in the absence of linguistic controls it became impossible to separate the effect of participation in the consortium's bilingual program from participation in the MICA program. Therefore, the following results must be viewed as exploratory or tentative.

The data summarized in Tables 16 and 17 show the relative scores between Spanish and English assessed during the pre-test (Table 16) and the post-test (Table 17). A comparison of the number of children receiving scores which are indicative of "minimal" proficiency (i.e., 1/1) in both Spanish and English for the pre-test was 5. For the post-test it was 2 for a net drop of 3. It would, in this way, be possible to examine a number of important relative changes between pre and post-tests. For example, in contrast to the above, where the number of "minimally" proficient children dropped from 5 to 2, the number of "maximally" proficient bilinguals increased from 6 to 16. Since there are any number of these

Insert Tables 16 and 17 about here

Table 16
Pre-Test RLP
Breakdowns

COUNT I / ROW PCT I / COL PCT I / TOT PCT I	ENGLISH 1	2	3	4	5	ROW TOTAL
Spanish 1	5	8	35	55	24	127
	3.9	6.3	27.6	43.3	18.9	50.0
	13.9	28.6	53.0	64.0	63.2	
	2.0	3.1	13.8	21.7	9.4	
2	6	2	4	2	2	16
	37.5	12.5	25.0	12.5	12.5	6.3
	16.7	7.1	6.1	2.3	5.3	
	2.4	0.8	1.6	0.8	0.8	
3	11	9	11	14	4	49
	22.4	18.4	22.4	28.6	8.2	19.3
	30.6	32.1	16.7	16.3	10.5	
	4.3	3.5	4.3	5.5	1.6	
4	10	2	9	4	2	27
	37.0	7.4	33.3	14.8	7.4	10.6
	27.8	7.1	13.6	4.7	5.3	
	3.9	0.8	3.5	1.6	0.8	
5	4	7	7	11	6	35
	11.4	20.0	20.0	31.4	17.1	13.8
	11.1	25.0	10.6	12.8	15.8	
	1.6	2.8	2.8	4.3	2.4	
COLUMN TOTAL	36	28	66	86	38	254
	14.2	11.0	26.0	33.9	15.0	100.0

NUMBER OF MISSING OBSERVATIONS = 53

Table 17
Post-Test
RLP Breakdown

COUNT I / ROW PCT I / COL PCT I / TOT PCT I	ENGLISH 1	2	3	4	5	ROW TOTAL
1	2	6	15	49	43	115
	1.7	5.2	13.0	42.6	37.4	44.6
	7.4	27.3	31.3	62.8	51.8	
	0.8	2.3	5.8	19.0	16.7	
2	1	1	3	6	1	12
	8.3	8.3	25.0	50.0	8.3	4.7
	3.7	4.5	6.3	7.7	1.2	
	0.4	0.4	1.2	2.3	0.4	
3	11	9	15	11	16	62
Spanish	17.7	14.5	24.2	17.7	25.8	24.0
	40.7	40.9	31.3	14.1	19.3	
	4.3	3.5	5.8	4.3	6.2	
4	5	2	5	3	7	22
	22.7	9.1	22.7	13.6	31.8	8.5
	18.5	9.1	10.4	3.8	8.4	
	1.9	0.8	1.9	1.2	2.7	
5	8	4	10	9	16	47
	17.0	8.5	21.3	19.1	34.0	18.2
	29.6	18.2	20.8	11.5	19.3	
	3.1	1.6	3.9	3.5	6.2	
COLUMN TOTAL	27	22	48	78	83	258
	10.5	8.5	18.6	30.2	32.2	100.0

NUMBER OF MISSING OBSERVATIONS = 49

types of comparisons that can be made, Figure 39 provides a graphic display of the changes between pre and post-tests for a number of groups defined on the basis of relative proficiency characteristics. In order to make the data more manageable, students were grouped according to relative oral language proficiency as follows:

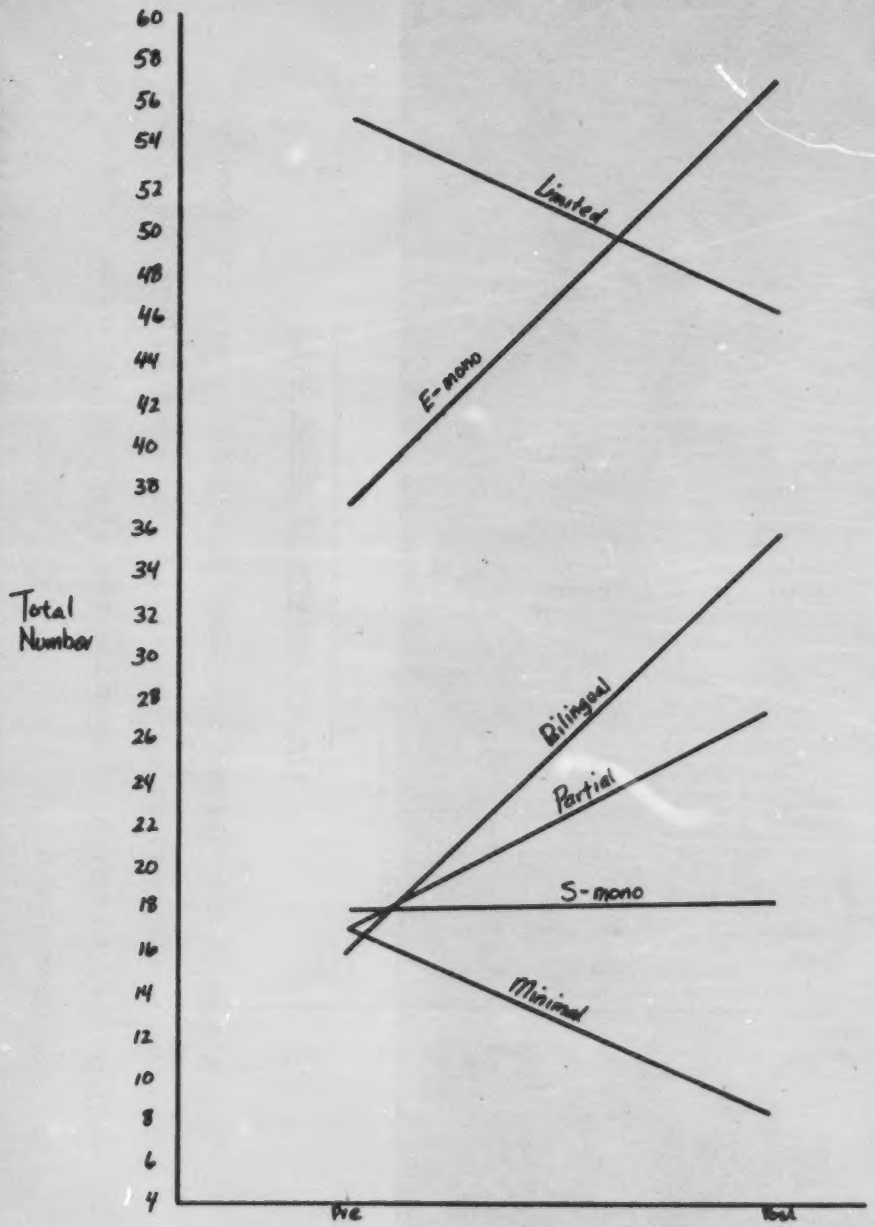
Relative Language Proficiency Groupings
English/Spanish

Minimal:	1/1, 1/2, 2/3, 2/2
Limited:	1/3, B/1, 2/3, 3/2, 3/3
Partial:	5/2, 5/3, 2/5, 3/5, 2/4, 4/2, 3/4, 4/3
Bilingual:	5/5, 5/4, 4/5, 4/4
E - Mono:	4/1, 5/1
S - Mono:	1/4, 1/5

Insert Figure 39 about here

Although the curves provided on Figure 39 are admittedly arbitrary with respect to the groupings, they do provide a convenient way in which to examine the shifting patterns between pre and post-tests.

As shown on Figure 39, the number of minimally proficient students dropped as did the number of "limited proficient bilinguals." In contrast, the total number of English "monolinguals," "partials," and "proficient bilinguals" increased. The total number of Spanish monolinguals remained unchanged. Taken as a whole, these changes seem to suggest an overall


60
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34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
Total Number
Limited
E-mono
Bilingual
Partial
S-mono
Minimal
Pre
Post
Number of Language Types

Figure 39.

increase in linguistic proficiency with the concomitant improvement of English and bilingual skills. As would be hoped for in any bilingual program, the number of children who were proficient in one language or another or both increased substantially.

Unfortunately, these data are limited by virtue of the fact that we have no direct comparison group such as was available for the achievement tests. It would be of great interest to examine the effects of the MICA program on each type of student. Through this analysis, it may be possible to further examine the question of uniformity of effect broached in an earlier section of this report. These results, along with a wide variety of others, will have to await further research. For the time being, the present results are only suggestive of further analysis. In addition, further support for the above general findings may be approached in a number of other ways in which the relationships between outcome variables and student types are examined. With respect to the relationships between the various outcome measures, an examination of the correlation matrix (Table 18) provides for a number of interesting closing observations on not only the effect of the program, but to a limited extent as the nature of the measures themselves.

The influence of prior learning on perception and the acquisition of new information has been a topic of interest

Insert Table 18 about here

TABLE 18

PRETEST AND POSTTEST CORRELATION MATRIX (PEARSON r / N / SIGNIFICANCE)

	CCS PRE	CCS POST	READ PRE	READ POST	MATH PRE	MATH POST	LAS ENGL PRE	LAS ENGL POST	LAS SPAN PRE	LAS SPAN POST	MINI ENGL PRE	MINI ENGL POST	MINI SPAN PRE	MINI SPAN POST	MINI 3 PRE	MINI 3 POST
CCS PRE	----	.575	.322	.331	.285	.292	.292	.244	-.234	-.208	.526	.511	.231	.383	.368	.083
		(201)	(194)	(186)	(181)	(172)	(235)	(207)	(238)	(206)	(140)	(140)	(48)	(48)	(63)	(66)
		.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.057	.004	.001	.254
CCS POST		----	.290	.294	.304	.421	.239	.283	-.085	-.069	.492	.498	.398	.478	.227	.111
			(171)	(215)	(158)	(201)	(207)	(246)	(209)	(245)	(141)	(141)	(49)	(49)	(62)	(65)
			.000	.000	.000	.000	.000	.000	.110	.140	.000	.000	.002	.000	.038	.189
READ PRE			----	.830	.656	.578	.483	.472	-.282	-.241	.631	.621	-.072	.213	.311	.271
				(172)	(168)	(160)	(196)	(176)	(198)	(175)	(132)	(132)	(27)	(27)	(53)	(56)
				.000	.000	.000	.000	.000	.000	.000	.000	.000	.360	.144	.012	.022
READ POST				----	.633	.683	.542	.521	-.211	-.286	.592	.669	.137	.338	.174	.236
					(158)	(204)	(187)	(219)	(189)	(218)	(133)	(133)	(41)	(41)	(56)	(59)
					.000	.000	.000	.000	.002	.000	.000	.000	.197	.015	.100	.036
MATH PRE					----	.685	.282	.309	-.090	-.137	.543	.556	.309	.315	.460	.343
						(155)	(184)	(163)	(185)	(162)	(124)	(124)	(24)	(48)	(51)	
						.000	.000	.000	.111	.041	.000	.000	.071	.067	.001	.007
MATH POST						----	.326	.277	.047	-.053	.505	.529	.280	.364	.186	.134
							(174)	(203)	(176)	(203)	(131)	(131)	(31)	(31)	(53)	(56)
							.000	.000	.267	.228	.000	.000	.063	.022	.091	.162
LAS ENGL PRE							----	.751	-.305	-.310	.419	.486	.141	.325	.167	.084
								(213)	(254)	(212)	(144)	(144)	(49)	(49)	(66)	(69)
								.000	.000	.000	.000	.000	.166	.011	.090	.247
LAS ENGL POST								----	-.226	-.245	.451	.492	.331	.411	.187	.233
									(216)	(258)	(143)	(143)	(51)	(51)	(65)	(68)
									.000	.000	.000	.000	.011	.001	.068	.026
LAS SPAN PRE									----	.903	-.417	-.285	.469	.305	-.109	.039
										(214)	(144)	(144)	(50)	(50)	(66)	(69)
										.000	.000	.000	.000	.016	.191	.376
LAS SPAN POST										----	-.401	-.273	.339	.442	-.130	.014
											(142)	(142)	(51)	(51)	(64)	(67)
											.000	.000	.008	.001	.154	.455
MINI ENGL PRE											----	.744	---	---	.363	.345
												(146)	---	---	(46)	(48)
												.000	---	---	.007	.008
MINI ENGL POST												----	---	---	.422	.284
													---	---	(46)	(48)
													---	---	.002	.025
MINI SPAN PRE													----	.491	.287	.257
														(51)	(15)	(15)
														.000	.150	.177
MINI SPAN POST														----	.687	.542
															(15)	(15)
															.002	.018
MINI 3 PRE															----	.317
																(66)
																.005
MINI 3 POST																----

to cognitive psychologists for the past several decades (Bartlett, 1932). The importance of prior educational experience was discussed recently (see Glasser, 1980) where it was suggested that to a large extent the amount of learning is predetermined by prior experience. In this way it can be expected that the low achieving child will continue to perform at a low level of functioning as will the high performing student continue to function at a high level functioning.

This rather pessimistic view can be taken to a logical conclusion which suggests a perfect correlation between pre and post-test administrations.

The only positive correlations found for the Spanish version of the MINI-test, as could be expected, was with Spanish oral proficiency as measured by the LAS. Finally, the relationship of MINI-III, which represents the concrete applications of the concepts tested in groups with the MINI-test with the other major variables is noteworthy. MINI-III tended to have higher correlations in the pre-test than it did in the post-test. One possibility is that there tended to be a ceiling effect in the post-test. Thus, reduced variance may account for the lower correlations found in the post-test. An alternative explanation, which is more in line with the current theoretical approach, would suggest that improvement on MINI-III is far less influenced by prior learning or experience. Therefore, changes in

post-test scores would be more influenced by programmatic effects as opposed to academic status variables.

Examination of the correlation matrix for the CCS shows fairly consistent, positive, low to moderate correlations across outcome measures which are in line with other research reported in the literature (see Kaufman & Kaufman, 1972; De Avila & Pulos, 1978) administered at different points in time. An estimate of the percentage of variance accounted for can, accordingly, be taken as a test of the null hypothesis; that there will be no change between pre and post-tests to the extent that post-test scores are predicted by pre-test scores. Under this model the percentage of variance remaining unaccountable for would be attributable either to factors such as program intervention, error (due to a possible lack of reliability) and/or other moderator variables. A summary of the extent to which pre-test scores were predictive of post-test scores is provided below (Table 19).

Insert Table 19 about here

As is readily apparent pre-test scores on all of the outcome measures were to a greater or lesser extent predictive of outcome scores. The most striking was for the Spanish oral language proficiency where approximately 86 per cent of the total variance in post-test scores was accounted for by pre-test scores. The least predictive was MINI-III where only 10 per cent was accounted for. In all, it could be said that, with the

Table 19

Correlations Between Pre/Post Tests

&

% Variance Accounted For

Test	R	R^2
CTBS Reading		
Vocabulary	.775	.600
Comprehension	.783	.613
Total	.830	.689
Math		
Computation	.577	.333
Concepts	.647	.419
Applications	.556	.309
Total	.684	.468
CCS		
Length	.362	.131
Number	.129	.017
Substance	.405	.164
Distance	.383	.147
Horizontality	.343	.118
Volumne	.354	.125
Probability	.354	.125
Ego-centricity	.420	.176
Total	.575	.331
LAS(E)		
Comprehension	.567	.321
Production	.680	.462
Total	.751	.564
LAS(S)		
Comprehension	.611	.373
Production	.892	.796
Total	.930	.865
MINI(E)		
Total	.744	.553
MINI(S)		
Total	.491	.241
MINI III		
Total	.317	.100

possible exceptions of MINI-III and Spanish oral language proficiency, pre-test scores accounted for a significant proportion of the variances in post-test scores. An interesting extension of this approach would be to determine the influence of other variables on pre/post test relationships through the use of partial correlation or other regression techniques. For example, it would be interesting to examine the extent to which the high correlation between CTBS pre and post reading scores is influenced by LAS English oral proficiency. Partial answers to this type of question are, to a limited extent, provided by examination of the correlation matrix provided on Table 19.

The correlation between English oral proficiency and school achievement variables show a moderately strong relationship between LAS, reading, and math scores. The correlations between reading and LAS scores were all statistically significant across both pre and post-tests. The range of correlation coefficients was between .54 and .47. The relationship between LAS and math scores was also positive, correlations ranging from a low of .28 to a high of .32. These would seem to reinforce or support previous research (De Avila et al. 1979) which has demonstrated the necessity of oral language proficiency for school achievement. In this connection, it is interesting to note that the positive relationship between LAS and CTBS scores is also evidenced by the relationship between MINI-test scores and both CTBS

and LAS scores. Although the MINI-test was designed as a content referenced test of the curriculum, this finding would suggest a fairly strong linguistic component. A content analysis of the MINI would tend to support this interpretation since several sections strongly emphasize vocabulary development.

In the same way as linguistic proficiency seems to be a necessary condition for school achievement, intellectual development also seems to be of some importance. The correlations between CCS, CTBS, reading/math, and MINI-test are not much different or lower than the same set including LAS scores. In fact, it is quite surprising to note a negative correlation between CSS pre-test and LAS Spanish. Since the same negative correlation did not seem to recur in the post-test, one could suspect a problem in CCS pre-test administration.

As a final comment on the correlations, it is of some interest to note that oral proficiency in both Spanish and English was positive with scores on the Spanish MINI-test, whereas the same was not true to either the achievement or CCS variables where the correlations tended to be negative. Similarly, LAS Spanish and English scores were negatively related. This variability as discussed above, would tend to suggest a complex set of relationships between linguistic proficiency in the two languages and program outcomes.

III. SUMMARY & CONCLUSIONS

This report describes and summarizes the results of a program designed to improve the intellectual, academic, and linguistic functioning of children in a linguistically and culturally mixed setting. The program, Multicultural Improvement of Cognitive Abilities (MICA), was installed and supported by project staff in nine participating classrooms, under two experimental conditions, intensive and economical, with the difference being in the extent to which they were supported by project staff. The program activities, taken from FO/D, were provided to all participating classrooms in addition to an ongoing bilingual program. Children were presented with the opportunity to engage in approximately 100 math/science activities and experiements. Each activity was self-contained, and, in most cases, required students to follow written instructions and to complete worksheets requiring basic mathematic and literacy skills. Program participants engaged in activities individually or in small groups which necessitated a high degree of cooperation and verbal interaction both with the teacher/aide as well as with peers. Program effects were measured by tests of (1) Academic achievement in basic skill areas (CTBS), (2) Oral linguistic proficiency in Spanish and English (LAS), (3) Intellectual development across Piagetian based tasks (CCS), and (4) Program content assessed in both structured and non-structured settings (MINI & MINI-III).

The above analyses were based on 253 students in grades 3 and 4 who participated in the program for approximately 10/12 weeks. Children engaged in the math/science activities for approximately 1/2 to 1 hour per day in addition to their basic course of study. Program effects were examined in a variety of ways which focused on treatment or condition by school, sex, and age variations.

In the first series of analyses, program effects were examined by time, condition, school, sex, and age across each set of dependent variables, separately. Thus, in the first series of analyses consistent pre/post test score gains were found for all important measures. To some extent, gains interacted with treatment or condition, and school variations. Condition was significantly related to program impact on five of the eight outcome measures.

School by school variations were statistically significant in five of the seven analyses conducted. At this point, it is important to note that, to a large extent, school and conditions were covariate since condition was defined on a school by school basis. Results show that there were, nevertheless, significant variations between schools even with the same conditions.

Examination of sex differences resulted in negligible differences. There were virtually no meaningful differences between boys and girls as to either differences in base rates or program impact. In the two cases where differences were

were found (CCS & math achievement), comparison of the absolute differences revealed the differences to be psychologically meaningless.

In addition to examination by time, condition, school, and sex, age differences were examined. The total population was divided into four age groups. In this particular set of analyses, data were then analysed by an age group rather than by grade in order to minimize the effects of "overaged" children, a problem which is characteristic of language minority research.

Age group comparisons revealed age to be highly significant across virtually all of the outcome measures. A more detailed examination of the cell means suggested that the significant age effects were due to the oldest of the four age groups. Comparisons of pre and post cell means for each of the four groups showed the program to have been least effective for group four. Moreover, examination of language data suggested that this group tended to be made up of primarily monolingual Spanish speaking students. While this group constituted only about 7 per cent of the total MICA population, the data do suggest the need for further examination of the interaction between age and language characteristics. In this connection, it would be important to bear in mind that not all of the Spanish monolingual students were overaged or in the oldest age group. Moveover, even this group had shown substantial positive growth on both CTBS math and CCS measures. Why similiar results were not found across the measures remains

a question. However, since language issues were not the primary concern of this report, answers to these types of questions will have to await more fine grained analyses.

In the second phase of the analysis, the performance of participating MICA students was compared to test norms and to several post hoc comparison groups. For a variety of reasons, this phase of the overall analysis of data was restricted to CTBS scores as direct controls across all of the outcome measures were unavailable. In the first set of analyses, two-way ANOVA results across MICA and comparison students resulted in significant main effects which were ultimately attributed to slightly larger gains for MICA students on third grade concepts and applications CTBS sub-tests. Unfortunately, data for these two sub-tests were not available for fourth grade comparison students; however, since most of the students participating in the MICA program were third graders (i.e., approximately 85 per cent), the results can be considered as indicative of the population as a whole. In all other comparisons, students participating in a bilingual program and MICA students showed consistent significant similiar gains in reading and math scores.

In a second set of comparisons, expected gains in academic content areas (i.e., reading and math) were calculated by obtaining the difference between norm raw scores equivalent to the 50th percentile for fall and spring test administrations. Fall and spring norm gains were then treated as "expected

gain scores" and compared with pre/post gain scores obtained by MICA and comparison group students.

Results of this analysis revealed that actual gains did not always match or exceed expected gains for both MICA and comparison students.

In a few instances, control students fell slightly behind the norms. Moreover, when control and MICA gain scores were compared, MICA students out-performed controls in a significant number of cases.

In the above series of analyses, comparisons between control and MICA students were made on an aggregated basis. In other words, it could be said that both MICA and controls showed improvement on the average. This finding was not, however, to be taken to mean that all students in both groups improved or gained on the norm. In an attempt to determine the extent of improvement, a third series of analyses were conducted in which the percentage of students gaining on the norm was calculated for each group and then compared to controls. Results of this analysis showed that with the exception of a small difference in reading comprehension, the percentage of students gaining on the norm was consistently greater for the MICA group. Consideration of these results should bear in mind that this analysis concerns the percentage of students who gained at least as much as would be expected by a comparison to fall/spring norms and not to whether or not students gained in an absolute sense.

An attempt was made to determine whether or not the MICA children who did not improve (i.e., gain on the norm) constituted a specific sub-group of the total MICA population. During the pre-test period, before the program began, teachers were asked to identify six to eight students who they felt were most likely to experience difficulty in mastering the basic curriculum or the math/science concepts. By this procedure a group of "problem" students, for whom the teachers had lower expectations than for their respective classes taken on a whole, was defined. Comparisons between the "problem" group and the remaining MICA group on both pre and post-tests showed the "problem" group to be consistently lower than the total MICA group. This is as would be expected. However, the absolute gain scores obtained by both "problem" and remaining MICA groups were virtually identical. In other words, even though the "problem" group scored lower on both pre and post-tests, their rate of improvement (i.e., absolute gain) was the same. Apparently, teacher expectation defined in this rather loose manner did not influence improvement in a direct sense.

The third phase of the analysis was both confirmatory and exploratory in an attempt to further check the above results and to provide preliminary information for possible future investigations. A number of issues were examined through the use of correlational results. Consideration of these data lead to a further examination of the effects of the MICA

program on the linguistic make-up of the MICA student population.

In a final series of analyses, correlational results were examined. The results revealed a high degree of stability in the relationships between the different tests which held across both pre and post-test administrations. Of particular interest was the relationship between linguistic and other variables assessed by the test battery. This led to an attempt to examine the extent to which improvement in oral language proficiency was consistent across subjects and languages. It was found that there were consistent shifts in a positive direction for both English and Spanish oral proficiency. These positive shifts were supported by a reduction of the number of children who in the pre-test were found to be of either minimal or limited proficiency in both languages. Unfortunately, this last series of analyses were not examined in terms of statistical significance due to a lack of appropriate controls. Results, nevertheless, did show a positive shift in the linguistic make-up of the total population.

The above results, on a whole seem to be highly encouraging as they reveal consistent positive gains which can be more or less attributed to experience in the MICA program. For a number of reasons, however, these should be accepted somewhat guardedly. In the following closing section of this report, it would seem reasonable to review and briefly discuss a number of limitations in the study. In closing, it would also seem reasonable to briefly discuss a number of direct implications as well as a number of analyses which could be considered for the future. Although the results of the analysis of program

impact on the linguistic make-up of the MICA population was limited by a lack of control or comparison subjects, they did tend to suggest a generally positive shift toward proficiency in either one language (particularly English), or the other, and to some extent proficient bilingualism. The total number of children defined as either "limited" or "minimally" proficient tended to decrease. On the other hand, the total number of students identified as proficient English speakers, proficient bilinguals, and partial bilinguals proficient in one of the two languages increased. Finally, the total number of monolingual Spanish speakers remained relatively unchanged. This latter finding is in contrast to previous research on the effects of bilingual programs which suggest a drop in Spanish proficiency over time (Saville-Trokie, 1973).

The work discussed in the above can best be described as "action research" in the best Lewinian tradition. The MICA program was dropped or added onto an already existing bilingual program and curriculum. In this sense, the experiment was conducted en vivo with all of the real life, daily inconveniences which plague the running of any program. It was not a laboratory study; hence, it was not possible to maintain total control over a number of variables which, no doubt, had their affect on the outcome of the study. The fact that there was significant classroom variation supports this conclusion. To a large extent, the fact that the MICA program was added onto an existing program is exactly why it was impossible to have

the kind of control one would seek to have in a laboratory setting.

One of the primary sources of uncontroled variation came from the teachers. Teachers and aides varied in any number of important ways which may have affected the direction of the outcome. Data on teacher variations was collected, but was not considered as part of the present report. It is, however, possible to discuss an informal assessment on one aspect or issue which may have been of contributory importance.

Consider again the issue of language. While these were "bilingual" classrooms, not all teachers or aides spoke Spanish or English, either equally well, or with equal frequency. For example, Spanish was used only rarely in schools two and eight. The failure to find improvement in Spanish LAS scores for these two schools is, therefore, totally understandable. Conversely, it is interesting to note that English scores improved in all cases with the exception of school eight. One is left wondering why this may have occurred. Further data revealed that, in contrast to most of the other classrooms, the MICA program in this classroom was primarily a teacher run experience. That is, the teacher did most of the talking and did not allow a great deal of verbal interaction. One might only speculate on the effect this would have had on student verbal performance.

Some teachers felt a great deal of pressure to complete the regular classroom objectives and did not see the science/math activities as complementing basic skill development.

Others did, and managed to work the activities into the regular instruction. Finally, several teachers felt that the activities would be too difficult, or too complex for the students. In a number of cases, however, it was interesting to observe changes in teacher attitude over the period of the program. Several teachers, in fact, commented on how they were surprised by the student's ability for self direction and concentrated effort.

In the same way teachers expressed initial doubts as to the student's ability to "do science," there were also several teachers who expressed doubt about their own ability to understand the content and purposes of the material. Furthermore, even though most of the teachers and many of the aides spoke Spanish, many were not initially familiar with either content of the activities or the Spanish vocabulary. And, as a result, there was a tendency in the earlier part of the program for several teachers to "shy away" from the content of the activities, and not to see their relation to the regular curriculum.

The points that can be made regarding teacher/aide attitudes must remain largely speculative. While the ethnographic information provided in Appendix A offers some insight into classroom variation, a great deal more work would be needed in order to understand the full impact of teacher/aide attitudes and expectations on student performance. Consider, for example, the question on the relations between teacher expectations and student outcomes. This topic has received a great deal of interest in the research literature; however, the present data has

some unique features.

First, it may well be that across all of the measures, not all of the students improved. We also know that student improvement was not restricted to "non-problem" students. An important question for future analysis becomes whether or not there is a consistent group of non-improving students across all of the outcome measures. In other words, is there a consistent group of children for whom nothing worked? Moreover, are there such groups in every classroom? To what extent do these students differ from one another in the extent and quality of their verbal interactions? To what extent is it possible to describe and predict their behavior on the basis of either academic or social status variables? Finally, to what extent are such children a necessary result of the underlying organizational structure of the classroom? For example, it may well be that regardless of content, teachers and aides can only get to so many children; the remaining are selected out in some way as losers. In a very preliminary way, we know, on the basis of the present analysis, that there was a group of older students in the sample whose improvement was not as consistent as it was for others. Only further ethnographic data, coupled with quantified analysis, will fully answer this question.

The fact that teachers were able to identify a lower performing group of "problem" students also gives rise to several other questions given that the "problem" students improved, or gained as much as the other students who partici-

pated in the program. The data described above would seem to suggest that, with this type of program and perhaps others, low expectations on the part of the teachers do not preclude improvement. The question becomes whether the low expectations held by the teachers are for low scores in an absolute sense compared to the norm, or whether teachers feel that what the students lack is capacity for improvement in a relative sense. Certainly, these data show that the "problem" students have the capacity for improvement. Whether or not they could fully catch-up to the other students, however, remains an unanswered question.

In this context, it would also be important to consider the difference between the approach embodied in MICA in contrast to other programs which attempt to improve thinking skills. For example, in the program described by Lipman (1980), students engage in Socratic dialogue concerning topics raised initially in the content of stories students were asked to read. This process, not only requires a level of verbal skill in order to "debate" the issues, but it requires a high level of reading skill. The program developed by Fuerstein, on the other hand, requires that a child go through numerous exercises aimed at developing specific skills such as those embodied in "scanning behavior." Lochead's program, like Fuerstein's and Lipman's, sets out a specific scope and sequence to the acquisition of a specific list of skills. The common feature to these three programs, from the point of view of the students, is their inductive nature. In contrast, while there are specific thinking

skills which are emphasized in FO/D, they are not presented in a direct fashion, but are embedded in the tasks themselves. In this sense, they are "abstracted" in a deductive manner over a large number of repetitions or activities which embody the same or similiar skills. Finally, in the FO/D approach, tasks may include a variety of thinking skills of different levels of complexity. In this way, the problem of developmental differences is avoided so that a child is able to "abstract" those skills which are within their developmental reach.

One of the major goals of the science/math activities is to facilitate the development of thinking skills. What is specifically meant by the term, however, is still in the process of being defined. A review of the literature on the topic uncovers a vast amount of research directed at identifying, training, and describing various perceptual and cognitive operations, all of which qualify as "thinking skills." On the basis of this review, one might be able to generate a list, or even a taxonomy of thinking skills. Such a list or taxonomy would, however, be inordinately long. Moreover, the generation of a specific list of thinking skills runs the risk of simply becoming another way to characterize the "deficits" of language minority students. Given these problems, and differences, it was felt that to a large extent some of the most important "thinking skills" were best broadly represented by the Piagetian tasks. These tasks, to a large extent, embody large numbers of superordinate cognitive or thinking skills which are theoretically ordered according to Piagetial theory. At the

lower end, the cognitive operations used in the concept of numerosity include such superordinate operations as: one-to-one correspondence, seriation, ordination, cardination, and so on. At the higher end, the superordinate concepts embodied in the notion of egocentricity or perspective would involve, not only those embodied in the concept of numerosity, but also involve the concepts of Euclidian space as well as the ability to reason in a way which is perhaps (from child's point of view) perceptually counterintuitive. It is this latter operation which, according to Piagetian theory, distinguishes cognition from perception, or "operative" from "figurative" knowledge, or thinking from perceiving.

In view of the above, the CCS gains exhibited by the MICA participants are worthy of comment. What they imply is that, to a large degree, MICA student's general level of thinking was improved by virtue of participation in the program. There are, however, several points which might be made regarding the extent of pre/post gains.

It will be, perhaps, recalled that there seem to be some questions on the validity of the CCS pre-test scores which were indicated by its negative correlation with Spanish pre-test scores. This might be taken to imply that higher Spanish speaking ability was associated with lower thinking skills. Several other explanations, however, seem more plausible since this finding tends not to be congruent with a significant number of other studies which have found only negligible positive results between LAS and CCS scores (see De Avila & Duncan, 1980).

One alternative explanation follows from a socio-linguistic consideration. Recall that, during the pre-test administration, there was some concern as to the Spanish oral language proficiency of the test administrators. This problem was corrected in the post-test. This would have led to lower scores in the pre-test and higher (more accurate) scores on the post-tests. While this interpretation is most appealing, it is perhaps not the best explanation. An examination of pre/post scores for English and Spanish monolinguals shows them to be virtually identical. However, an examination of the pre/post scores of children were identified on "minimal" proficiency in both languages reveals pre/post gains which far exceed either monolingual group or expected normative gains (De Avila and Duncan, 1980).

The concomitant improvement of linguistic and cognitive performance might also be explained in more general terms which would apply to the MICA group as a whole. A number of writers have suggested that the low academic (and, by extension, thinking skills) performance of minority students is the result of stylistic factors (see Fuerstein, 1979) such as "impulsivity" (see Kagan, 1963) and "field-dependence" (see Witken, 1950; Ramirez and Castañada, 1974; Pasual-Leone, 1976). What the above results may mean is that the effect of the program was not so much on the thinking skills of the students per se, but rather on their style or their approach to problem solving. Moreover, this would have particularly been the case for children who were identified as "minimally" proficient.

It would be indeed interesting to follow-up some of these conjectures with further analysis of the total data set. It would also be of great interest to examine the importance of a number of other factors not studied here. A mini-ethnographic study on the MICA project conducted by Navarrete (1980) would tend to support some of the above interpretations. Further analysis will, no doubt, be needed to support and add to these results. The fact, nevertheless, remains that there were significant improvements in the general thinking skills exhibited by the MICA students.

Moreover, it would appear that improvement in general thinking skills went beyond the Piagetian tasks to include linguistic and academic skills as well. The ultimate interpretations of this finding may well be to point out that there are classes of cognitive operations which can be positively influenced, and that this influence is best accomplished through non-specific instruction which allows for the great diversity brought to the classroom by linguistically different children. For an excellent discussion of the role of "non-specific experience" in the acquisition of conservation, see Wohlwill (1970). Also, see Cazden (1972) for a discussion on the effects of specific vs. non-specific language instruction. In other words, we are dealing with much more than a mere collection of Thorndike's cats (1924) able to learn only through either rote or trial and error methods.

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APPENDIX A

School Profiles (M2) 3rd Grade

Overall: Had a teacher switch during the course of the activities, approximately after the teacher had reached week 6 or 7 with the activities. The aide remained the same. The original teacher and the aide had participated in the pre-year MICA training. The new teacher had not had that training. The new teacher had an individual session with the project coordinator; and was able to discuss problems with MICA in her team meetings. She was in the intensive condition. The first teacher felt a lot of pressure from the principal to accomplish her 'objectives' and MICA was seen as a competing element--although it worked in a complimentary way, MICA was seen to take away from time directly spent on the task of the objectives. Notwithstanding the first teacher was very enthusiastic about MICA, as was the second teacher and the aide. The aide was sick alot initially. The second teacher followed the routines set up by the first, because we requested it.

SES data: (Prin) 85% of the students in this class were on free or reduced lunch.

Classroom Info: (TQ pre MICA) There were no special criteria upon which children were assigned to this class. Classroom was self-contained.

From the records (as of 4/10) for the target kids, absenteeism ranged from 0-24 days absent: 2 children were out 8 or 9 days; 1 child was absent 16 days; and 2 children were absent 21 to 24 days.

Teacher Info: (TQ pre MICA) The first teacher had 3 to 5 years teaching experience. She had used learning centers in non-core areas before (e.g. health & art). The second teacher had just started teaching; this was her first assignment. Both teachers and the aide spoke Spanish. The first teacher rotated tasks with the aide; with the aide's principal responsibility thought of as clerical--collecting monies from the students, recording grades. The aide occasionally gave original instruction to the large group or individual students, supervised student work, acted to give the teacher information about specific student behaviors.

The aide was present for 71/2 hours day. She was not a credentialed teacher.

MICA in this class: (observers recorded) comments Set-up & Management: Teacher and aide set up the activities before the period began; and cleaned up after it ended.

Facilitation: Teacher roved and monitored; occasionally she worked intensively with an individual group of students on a difficult concept; sometimes giving original instruction. The aide worked with individuals on worksheet problems. Most often she stayed where the more difficult activities were located.

Emphasis on the worksheets: There was heavy emphasis on the worksheets. The teacher checked every worksheet for spelling errors; and students had to hand them in to the teacher or aide before could proceed to the next activity.

Degree of understanding or trouble with the activities: Teacher may not have had a flare for science, but she went through each of the activity panels herself and tried to do the activities by herself at home from the panels before the kids used them; eventually the teacher and the aide divided up this task of getting to know the activities so that it became less burdensome and so that the aide understood more of the objectives for each task. At first neither the teacher nor the aide had a high degree of understanding and therefore had some trouble with the activities. Soon the teacher developed this practice of going through the activities, however, and things changed dramatically.

Use of Spanish: Spanish was used by the aide and by the teacher regularly to individuals and the group as a whole.

School Profiles (School B) 2/3 Grade

Overall: This school had 1 teacher and two aides consistently present during the experiment. All three participated in the MICA training sessions. The class completed the curriculum; and the teacher was extremely diligent about handing in all the materials we could possible desire--notes on students, notes on their own implementation of the curriculum, etc.

SES data: 45% of the class were awarded free or reduced lunch (Prin letter)

Classroom Info: There was no particular basis upon which students were assigned to this class. This was a self-contained classroom. The teacher was very concerned with giving the child a quality experience led by the teacher. From the records, for the target children in this class, absenteeism ranged from 3 to 13 days (as of April 1, 1980 4 children were out 3-4 days; 1 child was out 5 days; 1 child was out 7-10 days; and 1 child was out 13 days.

Teacher Info: (TQ pre MICA) Teacher has over 20 years of experience in teaching She speaks Spanish; has a Cuban background. She has used learning centers for subject matter core activities as well as ancillary activities (i.e. Math & fun). At the beginning of each day she plans for that day and rotates tasks with the aides.

Aides were present 4 hrs/day. Neither was a credentialed teacher. Primary responsibilities for aides were recording grades, collecting monies for lunch; supervising children's work; and providing information to the teacher on specific behavioral work issues for children. Occasionally the aides also did original instruction and diagnosing of student learning needs.

MICA in this class: Set-up & Management: Teacher and aides exclusively set up materials; Aides cleaned up.

Facilitation: Teacher worked intensively with students from 1 or 2 activities during a period. Students rotated through the activities on an assigned basis. Aides also supervised 1-2 activities each.

Emphasis on Worksheets: There was a box where children turned in their worksheets each day--once completed. This box was remarked upon by the teacher and whether a student turned one/some in for that week was checked; completion of a worksheet before proceeding to the next activity, however, was not a routine which the teacher intervened in.

Degree of Understanding of the activities: The teacher and at least 1 aide understood the activities very well and had little trouble with them. The second aide was very quiet and it was not clear how well she understood them as a whole; but the one she was working with at that moment she understood by virtue of the teacher's explanation, at least.

Use of Spanish: Spanish was used regularly to the group as a whole and occasionally to individuals.

School Profiles (School C) 3rd Grade

Overall: The school had 1 teacher and two aides participating in MICA. One teacher and one of the aides were trained in the MICA pre-year training. The SIP aide was not trained. The SIP aide also resented the time she had to spend on MICA "taking away" from her SIP work. The MICA activities were set-up and implemented in two separate spaces; the primary classroom and an empty room down the hall from the main classroom.

SES data: 17% were awarded free lunch or reduced lunch in this class (Prin letter)

Classroom Info: (TQ pre MICA) There is no particular criterion upon which children are assigned to this class. There was no particular time for MICA; it was woven in and around Math; the whole class did not do MICA at the same time. The class was self-contained; but there was an extra room available in which to set up MICA. Who implemented the activities in which room was/or seemed to be determined by the activity type. From the records, for the target children in this class absenteeism ranged from 4-18 days, as of April 1, 1980 2 children were out 4 days; 1 child out 5 days; 4 children were out 8-11 days; and 1 child was out 18 days.

Teacher Info: (TQ pre MICA) The teacher had 6-10 years teaching experience. She did not speak Spanish; although she had two years of Spanish in college and additional Spanish in high school. The one SIP aide also did not speak Spanish; the other aide spoke mostly Spanish and little English. This other aide was a school administrator from Chile. The teacher had experience with learning centers in the past, as a supplement to her regular teaching/learning program.

The aide(s) were present for three hours. There were no primary, set responsibilities for the aides. Tasks were rotated, and everybody did a little teaching, a little clerical work, a little diagnostic work, a little supervising of students, etc.

MICA in this class:

Set-up & Management: Aides set up (and cleaned up) the activities before or at the beginning of the MICA periods (and at the end).

Facilitation: Teacher wandered around the main classroom and supervised as needed; the aide took a group in the spare room and worked with them on 4 or so activities; the other aide worked with an activity in the main room.

Emphasis on worksheete: There was some emphasis; students often had to finish them at their desks before handing them into the aide or teacher. There was no sign-off procedure, but everybody was aware of them.

Use of Spanish: Spanish was never observed in use by the teacher to either group or individuals; by the aide it was occasionally in use to individuals and only infrequently in use to a whole group.

Degree of Understanding: Teacher and SIP aide moderate to lower; Spanish speaking aide Moderate

School Profiles (School S) 4th Grade

Overall: This school had a consistent teacher and aide during the activities. Both the teacher and the aide were trained during the MICA pre-service sessions.

SES: 84% were awarded free or reduced lunch in this class. (Prin Letter)

Classroom Info: (TQ pre MICA) There is no particular criterion upon which this class obtained students. The classroom was self-contained, and no outlets for water; it was in a portable.

Absenteeism ranged from 2 to 19 days out, for the target kids, as of 4/1/80. Five children were out for 2 to 4 days; three children were out 17 to 19 days.

Teacher Info: (TQ pre MICA) This teacher had 1-2 years of previous teaching and experience. Both she and the aide spoke Spanish fluently. The teacher had used learning centers previously in core areas of science and language arts.

The aide was present for 6 hrs/day. The primary responsibilities for the aide were supervising student work and clerical tasks of collecting lunch monies, preparing materials and recording student grades. Occasionally the aide also presented lessons to small groups and diagnosed student learning needs. The aide never provided large group instruction. Tasks were rotated as needed, based on standard operating procedures and teacher-teacher aide consultation.

MICA in this class: Set-up & Management: Students set up and cleaned up the activities at the beginning (and end) of the period.

Facilitation: Both teacher and aide roamed and facilitated as needed--either they noticed an issue or the student came up to them and requested help.

Emphasis on worksheets: Students were responsible for showing the completed worksheet to the teacher before proceeding to the next activity; and the teacher or aide checked it over then and there.

Degree of understanding: Teacher seemed to have a good grasp of the math activities and some of the science activities. On the whole she understood the principle behind the activities and how to do them. The aide seemed a little less clear but had a good understanding nevertheless.

Use of Spanish: Both teacher and aide used Spanish regularly to the students individually and as a whole group.

Other: This was primarily a student run experience. The teacher served as a structurer, facilitator and consultatn. Teacher occasionally had group introductions where they went over assignment to activity centers and problems with the activities.

School Profiles (School A) 3rd Grade

Overall: Had a teacher switch during the course of the curriculum. The first teacher went through the MICA training session. The second teacher did not. She got some individual attention from the project coordinator and staff. The aide, who had bben trained in the MICA session earlier and who had worked closely with the first teacher was able to help. The first teacher worked with the students through approximately week 6.

SES data: 61% of the students in that class were on free or reduced (Prin File) lunch.

Classroom Info: (TQ pre MICA) Students are assigned to this class on a LES basis. Both teachers reported trouble getting and keeping order. This was also noted by the observers. Class was in an open space setting with special noise problems to the extent that the school had called in a consultant to work with them on dealing with the issues.

From the records, we can get some idea of an absentee rate only for the target kids. The range was from 3 to 20 days; 2 children were out 3-4 days; 4 children were out 6-10 days and 2 children were out 15-20 days.

Teacher Info: (TQ pre MICA) The first teacher had 6-10 years experience previous to MICA. She spoke Spanish. She had experience with learning centers as a source of reinforcement for students. Wanted centers with structure; not a free-educational environment. Plans one day ahead for the next days work.

The aide was present for 6 hours a day in her class. The aide was not a credentialed teacher. Most common work modes for the aide previous to MICA were supervising student work and feeding information to the teacher on specific behavioral work issues for children in the class. The aide never asked to diagnose student needs. The aide occasionally recorded grades or collected lunch monies; or prepared a lesson in ESL for a subgroup of children; never did other original instruction.

MICA in this class: Set-up & Management: Usually done by teacher and aide. Sometimes students helped. Aides and students cleaned up.

Facilitation: Teacher roved and monitored; aide was usually stationery for a given activity. Students decided where to go next by what was free or special assignment.

Emphasis on worksheets: Had to finish before proceeding; they were not signed off upon however.

Degree of understanding or trouble with activities: First teacher had some trouble, but generally understood what had to do; second teacher had much more trouble.

Use of Spanish: Spanish was used regularly by the teacher and aide to the whole group and individuals in the class.

Other: The first teacher was enthusiastic about the activities byt appeared overwhelmed about the amount of work they entailed. This was only increased when the second teacher came in. Overall, both teachers were enthusiastic about the project. They wanted a quality experience and student cooperation.

School Profiles (MI) 3/4 Grade

Overall: Had two aide switches, both right at the beginning of the year; the same teacher during the course of the year, however. Teacher had been trained in good Spanish; aide (final aide) did not speak Spanish. The teacher participated in the training workshop; the final aide had not participated (the initial one had).

SES data: (Prin) 74% of the students in this class were on free or reduced lunch

Classroom Info: (TQ pre MICA) Students are assigned to this class on a LES basis, however, some FES students are also added to the class on principle. Teacher very particular about who worked her students; initially this created special project problems later (once trust built up) there was not a problem. Classroom was self-contained.

From the records (as of 4/1) for the target kids, absenteeism ranged from 0-28 days out: 4 children were out 0-4 days, 1 child was out 7 days; 1 child was out 12 days; 1 child was out 17 days; and one child was out 28 days.

Teacher Info: (TQ pre MICA) This teacher had 11-20 years of teaching experience. She speaks Spanish; although she may not be native to it, she speaks it well. She has had experience with learning centers for core learning: language arts and social studies. At the beginning of the year she figures out the general roles for the teacher and the aide.

The aide was not a credentialed teacher. She was present for 5 hours/day. The aide (final one) did not speak Spanish. Principle responsibilities were all except clerical which were done occasionally.

MICA in this class: (Observers recorded) comments Set-up & Management: Usually done by Teacher, Aide + 1 or 2 students during latter part of lunch before MICA began; kids & aide cleaned up at the end of the period.

Facilitation: Teacher began each MICA with a group session (also ended each session with a group meeting) in a circle where discussed activities, interesting findings and special problems. Teacher generally roved and monitored helping as needed. If there was a particularly difficult task, they often worked intensely with that group; aide worked with usually a selected activity or activities; sometimes aide would rove.

Emphasis on worksheets: Worksheet emphasis was not verbalized during the MICA period; nor was there a marked place in the class to turn them in. Kids did work consistently on them, however, and they seemed to be a goal for completion of the activity.

Degree of understanding or trouble with the activities: Teacher had a clear understanding of the activities; the understanding of the aide was very good also.

Use of Spanish: Teacher used Spanish regularly to the whole group and to individual children; aide did not speak it.

Other: This class was almost entirely student run with the teacher acting as a consultant and facilitator. Teacher was very enthusiastic about the materials and the project.

School Profiles (School G) 3rd Grade

Overall: This school had a teacher and an aide, who were consistent over the course of the activities. The teacher was bilingual in E/S; the aide only spoke English. The teacher participated in the pre-year MICA training session; the aide did not participate.

SES data: 81% of the students in that class were on free or reduced
(Prin letter) lunch.

Classroom Info: Students were not assigned to this class on any
(TQ pre MICA) specific criterion. Class was in an open space setting; noise was a consideration; also a consideration was the attractiveness of the activities to the other classes of students in the pod not using them. The fact that students were intrigued by the activities they saw going on in this class irked (or seemed to irk) the other non-participating teachers in this pod. This was not a serious problem, however.

The records show an absenteeism rate for the target children in thi class (as of April, 1980) which varies from 1-24 days; 3 students had been out 1-4 days; 3 students were out 10,11 days; and two students were out 20-24 days.

Teacher Info: This teacher had 1-2 years of experience with migrant
(TQ pre MICA) programs before the MICA experience. She spoke Spanish. She had experience with learning centers and with science; that was the way in which she had handled the migrant programs (i.e., with OBIS--Outdoor biology instruction in Spanish). She plans that morning for the day.

The aide was present for 6 hours; this aide did not speak Spanish. Tasks were rotated. Primary responsibility involved presenting lessons to small groups or individual students; supervising student work; recording grades and collecting monies (but not preparing materials); and providing information to the teacher on specific student behaviors. Occasionally the aide also provided large group instruction. The aide never would diagnose for individual student learning needs.

MICA in this class: Set-up & Management: 2 or 3 kids set up and cleaned up the activities during the recess before MICA.

Facilitation: Teacher roved and monitored and answered questions or extended as need be; aide sometimes roved and monitored; sometimes watched a particular activity; and often stayed on sidelines.

Emphasis on worksheets: Very little emphasis; no sign off; no place to put them underscored.

Use of Spanish: Teacher regularly used Spanish both to individuals and to the group as a whole; aide did not know it.

Degree of understanding of activities: Teacher understanding of both activities, management concepts and some of the learning concepts was very high; aide's seemed very low. Teacher could tell at a glance it seemed, why an experiment wasn't or was working.

School Profiles (School O) 2/3 Grade

Overall: This school had one aide and one teacher, consistently through the course of the activities. Both spoke Spanish. Only the teacher participated in the pre-year MICA training session, becasue the aide's family was sick.

SES data: 93% on free lunch or reduced lunch (teacher)

Classroom Info: Students are not assigned to this class on the basis of any special criterion. Classroom was in open space. This did not seem to cause any special problems or benefits. The only problem was that there was a rug and the activities using clay and the one where they had to mark the footsteps with chalk greatly annoyed the janitor who had to clean up the rugs later. This seemed to be enough of an annoyance that future activities involving clay or chalk markings will probably be eliminated in their use.

Records were not available to us at the school level or classroom level concerning absenteeism. The teacher made an estimate of the amount of absense for each of the target children, however; according to this estimate, as of April 1, absenteeism ranged from 0 to 5 days out. Four children were never absent, 2 children were absent approximately once a week or 25 days. One child was out once or twice a week, totalling approximately 35 days out.

Teacher Info: (Pre MICA TQ) This teacher had 1-2 years of previous teaching experience. She spoke Spanish fluently. She had experience with learning centers in core subject areas (e.g. reading) and thought they were adequate. Generally the teacher decides alone what is to be done in the class or there is a standard operating procedure. The aide does not have any primary responsibility. She rotates supervising students, doing clerical tasks, and serving as an informant for the teacher on particular student behaviors. The aide is never expected to plan or teach a lesson or to diagnose student needs.

The aide was present for 6 hours a day. She was not a credentialed teacher.

MICA in this class: (Observer recorded) comments Set-up & Management: Usually done by the aide before the actual period; students would clean up themselves after the period was over. Sometimes the children helped set-up too.

Facilitation: Teacher roved and helped as needed. Often she stayed more or less in the center and children came to her. The aide wandered also; sometimes she was stationery with a particularly difficult experiment to help the kids get through.

Emphasis on worksheets: There was moderate amount of emphasis on the worksheets. Students worked at center tables to get the worksheets completed; they then handed them into the teacher; the teacher did not go over them.

Degree of understanding or trouble with the activities: Both teacher and aide had an excellent understanding of how the science activities worked. Whether there was an understanding of the purpose or concept behind the MICA activities seems questionable. Getting through the activities seemed to be a theme.

Use of Spanish: Both teacher and aide used Spanish regularly with both individuals and the group as a whole.

Other: This class was almost entirely student run. There was not any problem for a student in figuring out what to do next or where to go next; a standard operating procedure had been worked out that worked.

School Profiles (School W) 3rd Grade

Overall: This school had a consitent teacher and aide during the activities. Both the teacher and the aide participated in the pre-year MICA training session. This school was very slow in implementing the activities, however, and seemed to feel there were great management problems. The teacher split up when she used to MICA to fit into a number of different pockets during the day and was not consistent when she used the activities.

SES: (Prin) 85% were on reduced or free lunch and qualified for AFDC

Classroom Info: (TQ pre MICA) There was a bilingual criterion used to determine the students for the class. LES. The class was self-contained.

Absenteeism ranged from 0 to 23 days for the target students here, as of 4/1/80: 1 student was never absent; 1 student was absent for 5 days; 3 students were absent for 7-9 days; 1 student was absent for 14 days; 1 student was absent for 23 days.

Teacher Info: (TQ pre MICA) This teacher had 6-10 years of teaching experience. Both she and her aide spoke Spanish. She had had experience using learning centers previously in curricular areas.

The aide was present 51/2 hours a day. They decided at the beginning of the year how they would divide up the tasks. Primary responsibilities for the aide were planning lessons for the whole group; supervising work clerical tasks such as collecting lunch monies, and feeding information to the teacher concerning particular student behaviors. Only occasionally would the teacher aide present lessons or diagnose student learning needs.

MICA in this class: Set-up & Management: Teacher and aide set up the activities before the actual period.

Facilitation: Often the whole class did one activity which the teacher demonstrated. At these times the aide did not participate except as requested by the teacher. At the beginning of the activities, students worked on their own and the teacher worked primarily with one learning center and the aide with another. Teacher and aide had to sign off on worksheets, so their work with a learning center was generally fitful.

Degree of understanding: Both teacher and aide had a hard time understanding the activities. Neither did them at home or pre-read the panels before introducing them to the children; neither had a flare for science.

Use of Spanish: Rarely was Spanish used by either teacher or aide toward the whole group; and at most only occasionally was it used by the teacher to individuals; the aide rarely used Spanish in part because she did not interact too much, perhaps.

Other: This was primarily a teacher-run experience. The structure of the class resembled what another whole class instruction experience would be like.

Attachments; NIE Grant 78 0158 FINAL REPORT February 1981
Devila, E, Cohen, E.G., Intili, J.K.

DESCRIPTION OF THE CURRICULUM AND UNDERLYING RATIONAL

Finding Out, and its Spanish counterpart, Descubrimiento, provides a science and math curriculum which encourages the intellectual development of children in grades K-5 through individual questioning and experimentation. Learning how to learn, the development of a questioning attitude and logical thought, is emphasized throughout the Finding Out activities. These activities draw on the applications of science and mathematics in everyday life common to most children regardless of language or culture. This introduction will offer a brief overview of the theoretical background of Finding Out, its purpose, the subject areas and skills it covers and its method of implementation.

Finding Out is based on the concepts of cognitive development propounded by the Swiss psychologist Jean Piaget, who held that intellectual development occurs in hierarchically ordered stages which follow the same sequence for all children. This progression is analogous to the sequence of motor development. For example, an infant practices a seemingly random assortment of motions before s/he synthesizes them into crawling, then uses crawling to explore the world further. Likewise, an older child will experiment with certain materials until s/he grasps their organizing principle, then proceeds, with that principle as a tool, to the next stage of development. "Force-feeding" a curriculum to a child does not produce learning; each child will learn a given concept when s/he has developed the conceptual framework within which to understand it. Given sufficient exposure to experiences at one level, a child will learn what s/he needs to progress to the next level. This is Piaget's notion of "horizontal decalage", precisely the purpose of Finding Out. In other words, the intended purpose of the activities is not so much to "accelerate" transition from one Piagetial substage to the next, but, rather, to "enrich" the repertoire of each child regardless of developmental level. It is the lateral or horizontal as opposed to a "vertical"

emphasis which distinguishes the Finding Out approach from other approaches. Thus, through the enrichment of the horizontal decalage, vertical development takes place.

By asking children to explore and experiment with intrinsically interesting materials and phenomena, Finding Out provides opportunities for children to gain experiences at their individual levels of need. Each child takes from an activity what is appropriate to his/her stage of development. For example, making a seesaw balance can give one child the chance to explore the concept of equalities and inequalities, while it offers another child experience in measuring with numbers and a third the challenge of drawing conclusions about what is needed to achieve balance. In each case, the child is working at his/her individual level, regardless of chronological age or grade, and is learning to think about a problem in ways which transfer readily to other situations.

Finding Out is organized by themes: Change and Measurement; Shapes and Simple Machines; Crystals and Powders; Shadows, Light and Navigation; Space and Flight; Photography and Optics; Balance and Structure; Electricity and Magnetism; Heat and Sound; and Water. Within each theme, there are both science and math activities of varying degrees of difficulty. The concepts to be grasped--principles of physics and mathematics--transcend any particular language, but the activities themselves are sufficiently interesting to generate the need for the use of language. Language skills grow as children ask questions and describe what they see and do. This method provides for learning in context, rather than abstract, mechanical acquisition of disjointed facts.

This learning-in-context approach has special value for language-minority children. First, the thought processes developed and the knowledge gained are independent of language. Second, Finding Out, based on tasks which are interesting in their own right, eliminates the common doubt, "Why am I studying this?" Using cartoon-illustrated cards, the activities insure student comprehension of what to

do, regardless of reading ability. In addition, when the Finding Out activities are used in tandem with the Descubrimiento activities, a student may refer back and fourth to make sure s/he knows a given word or phrase.

While the Finding Out activities emphasize how children think through a given problem they also provide children with the experience needed to master skills necessary for progress. Specifically, these skills include making correspondence, sorting, ordering, measuring with and without numbers, using the metric system, comparing, estimating, predicting, making inferences and testing hypotheses, using arithmetic symbols and operations (including linear coordinate, area, volume, and ratios), and understanding relationships. Language development takes place in the course of these activities as students need to learn new words, read directions, and write.

REPORT OF THE MICA PILOT TEST[1]

Background and Description of the Test

The test which was administered at Slonaker Elementary School is part of the MICA Project activities, Finding Out/Descubrimiento, developed by Dr. E. A. De Avila.[2] Finding Out/Descubrimiento attempts to develop students' problem solving capability in a math and science context. It consists of 170 experiments revolving around the themes of Change and Measurement, Shapes and Simple Machines, Crystals and Powders, Shadows and Navigation, Space, Heat and Sound, Photography and Optics, Balance and Structure, Clocks and Pendulums, Magnetism and Electricity, and Water. The experiments are to be implemented in a learning center format. Each was developed to engage students' attention while proceeding from easier to more difficult concepts. Each child performs all the experiments. Understanding of science concepts is developed on the basis of their experiences and is reinforced both by their own descriptions of these experiences on worksheets which accompany the experiments and by teachers' facilitation of the experiments.[3]

The MICA mini-science test was developed because we could find no existing test of science concepts which was appropriate for bilingual contests, and also probed students' capabilities for problem solving. The test we developed has three sections (vocabulary, application, and performance), and is designed to be relevant to Finding Out/Descubrimiento activities. A copy of the entire instrument is provided in Appendix B. The test administered in Slonaker Elementary School was Part III of the Mini-test.

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[1]MICA Project, prepared by Dr. Jo-Ann K. Intili, Coordinator, in collaboration with Ms. Susan Hanson.

[2]The test was developed by Dr. De Avila in conjunction with Ms. Susan Hanson, as part of the MICA Project, funded by the National Institute of Education, under the auspices of Grant NIE-G-78-0158.

[3]See Appendix A for a fuller description of the Finding Out/Descubrimiento.

The test is administered in the child's primary language, either English or Spanish. Students taking Part III are tested individually (the other two sections are group administered)*. Part III takes about 20 minutes per child to complete. Each child is presented with thirteen tasks to perform, representing understanding of the concepts of solid and liquid measurement, using instruments calibrated on the metric system, spatial configuration, weight and mass, graphing, and probability. Students exhibit their proficiency with these concepts in the performance of these tasks and are scored as having mastered the concept or not. The tester tries to go beyond superficial understanding of the concept by probing for the underlying reasoning. In probing understanding of the spatial concept of "opposite", for example, the tester moves the pencil to another location on the paper and repeats the request that the student place his or her own pencil "opposite" the tester's. In this way the test attempts to avoid a multiple choice framework and tries to encourage the student to demonstrate transfer of training. The test tries to encourage the student to estimate and then discover the accuracy of that estimate for him or herself.

Function and Description of the Pilot Test

The purpose of piloting the MICA test was three-fold: First, piloting was to find if the test items were either too difficult or easy for students having similar backgrounds to those currently engaged in using the activities. Second, there was concern that certain aspects of the test materials might affect the response. Third, we were concerned to find out if the performance nature of the test (as opposed to pen and pencil) was viable and if the test would be well-received by the students.

The test (13 items) was administered to 20 children in Ms. Norma Ramirez' third grade class at Slonaker Elementary School by two administrators. One administrator was bilingual, English and Spanish; the other was monolingual English speaking, with minimal Spanish proficiency. Nine students were adminis-

*See Appendix B for copies of the entire MINI Test in English and Spanish.

tered the test in English; ten students took it in Spanish. Twelve of the students were female; five were male. Ages ranged from seven through ten with the majority being 8 years old. One optional item was administered to 5 students to determine its potential as a substitute.

Results

The results are presented in detail in Appendix C. Table 1 below, however, summarizes the results.

Table 1

Distribution of Responses of Items on the MICA Mini III

(n=20)

Item	Number of Students Who Were Scored As Follows: Correct	Incorrect	Item Not Given
1) ". . . How many pencils long is this piece of tape?	17	3	0
2) ". . . Place your pencil on the opposite end of this piece of paper.	9	11	0
3) ". . . Please measure the edge of this box. How long is it?	12	8	0
4) ". . . How would you find out which container holds the most lemonade?	2	18	0
5) ". . . Please measure the width of the picture.	5	15	0
6) ". . . Please draw the bars for the graph.	4	16	0
7) ". . . Please pour about 250 milliliters into my cup.	3	17	0
8) ". . . How long is this piece of tape? (Using one pencil to measure it.)	6	14	0
9) ". . . Can you estimate which object is heavier? Please weigh each object and tell me which is heavier.	8	2	9*
10) ". . . Do you think the same person will go first each time? (Using a coin toss.)	3	17	0
11) ". . . Martha said the cheese weighed 27 meters. What's wrong with this?	2	18	0
12) ". . . Please pick the objects that will float. (sponge, cork, straw, nail)	15	5	0
13) "Which of the following (spoon, sponge, knife, ball, water, powdered drink mix, rubberband) would you:			
a) stir with	12	8	0
b) use to slice	19	1	0
c) bounce	16	4	0
d) boil	9	11	0
e) dissolve	6	14	0
f) stretch	15	5	0

* The reason why this was not administered to 9 students was that only one scale was working properly.

As is shown in the table, the first conclusion we were able to draw was that there was substantial variation in the ability of the children to answer each item correctly. Items 1, 12, and 13b, c, and f were apparently the easiest (using successive pencils to measure length, picking objects which would float, knowledge of vocabulary for slice, bounce, and stretch). Items 4, 7, and 11 were evidently the hardest (judging how to discover which container holds more water, estimating the amount a container holds, given knowledge of a metric liter and weight measurement. Students tended to miss items for two basic reasons: 1. They had not studied these concepts and words as part of their classroom science program; and 2. Their cognitive development was inadequate for understanding the solution of the item.

The three items on the test which clearly required a particular vocabulary to answer the questions correctly were items 7 and 11. They contained metric references which the student would need to be familiar with in order to answer them. Question 5 required that the students know the difference between "width" and "length". Such questions are appropriate for our test because Finding Out/ Descubrimiento contains several activities using metric units of measurement, and requires the children to measure specific dimensions of several objects. However, for children not using the activities, these items would be difficult.

The questions on the test which tested the developmental level of the children were incorporated because we are curious as to what extent the mere opportunity to have certain experiences will affect the developmental level of the child. Together questions 1 and 8 nicely demonstrate how the developmental level of the child affects his/her ability to answer particular questions. The students at Slonaker had little difficulty answering question 1 in which they were given several pencils and asked to lay them out in a line in order to measure a piece of tape (use of nonstandard units). In contrast, many students had a difficult time answering question 8 in which they were asked to tell how long the piece of

tape was using only one pencil. (This requires marking the end of the pencil with one's finger and counting the number of times the pencil fits on the tape.) It was clear that several children were almost at the stage in which they could handle the problem posed by question 8. Such children demonstrated that they understood the problem at hand by repeatedly laying the pencil down in several places on the tape or using two fingers to mark a standard unit of space and then repeating it.

The students also had trouble answering questions 4 and 10 which involve measuring capacity and understanding probability (respectively). Many of the children used visual perception to answer question 4. They really had no idea how to use a nonstandard cup to measure which container could hold more water. The most frequent tactic was to look at the two containers without water and to guess which one was larger. When I prompted them to use the water to measure which container actually held more, they filled each one with water (without counting the number of cups used), and then looked at them again and made another guess.

If we include the vocabulary words in item 13, the children in Ms. Ramirez' class generally scored correctly on about half the items. For our purposes, this was what we had hoped. Examination of the items missed will give an indication of what concepts could be targeted for extra work. These are, in particular, measurement.

Conclusion

From these test results it seems evident that most of the children in Ms. Ramirez' class would benefit from activities which encourage them to measure things. Measurement instruction activities typically begin with encouraging students to discover what measurement is. Students have fun discovering that they can measure things with parts of their body such as their hands and feet.

When different results are obtained from measuring the same objects, it then becomes apparent that a standard unit of measurement is needed. Students can then go on to use standard objects found around the classroom (e.g. paper clips, unsharpened pencils, etc.) to measure items and find that now they all obtain the same measurements. At this point customary units (i.e. inch, foot, centimeter, meter) can be introduced as a convenience for communicating with people all over the world. After the students have acquired a basic understanding of what it means to measure length, they should learn to record and compare their measurements by graphing the results (e.g. picture graphs, bar graphs). A similar progression can be used to introduce the measurement of area, liquids, and weight.

Since the United States is currectly in the process of going metric, a variety of materials have been produced which contain activities of this sort. While a minimal budget to buy measuring instruments (i.e. rulers, scale, measuring cups) is needed, things to measure can usually be found around the classroom or home.

There were other results of the pilot test. These concerned the use of materials. As a consequence of the opportunity to use the MINI in Ms. Ramirez' class, we were able to see that slight deviations in materials could influence performance. We were also able to see that some children should perhaps take the test in both English and Spanish.

In general, the test appeared to be well-received by the students, as well as viable. Although many of the children missed several items, the administrators reported that most of them seemed to enjoy taking the test. It was a fun test in which the students had an opportunity to measure a piece of tape, pour water into cups, and drop things in a bucket of water to see which things sank and which floated. Achieving this was one of our aims: i.e. to overcome test shyness and obtain a good understanding of a child's proficiency with certain concepts.

Other results of how certain individuals in the class did are included in Appendix C. The table included in Appendix C gives item by item responses for each child in the class who was tested by MICA.

We greatly appreciated the opportunity to pilot our test in Ms. Ramirez' class, the cooperation of the district office and the cooperation of the principal at Slonaker Elementary School, Mr. Howard Cooke, in expediting the process. The pilot test results suggest the need for a bilingual curriculum (such as the one which we are using in the MICA study) which encourages students with backgrounds similar to those at Slonaker, to have a wide variety of experiences with "hands-on" science tasks. Measurement skills are consistently used by adults, and they are the type of skills that one can only learn by doing. We are hopeful that our study will provide evidence that exposure to an activity-oriented curriculum, such as Finding Out/Descubrimiento, does help bilingual students in a variety of ways. We will be sure to forward the results to you, in any case.

December, 1979

No. _____ Name _____

School _____ Boy _____ Girl _____

Grade _____ Condition _____ _____

Age _____

Teacher _____

Finding Out
Booklet

Section I _____

II _____

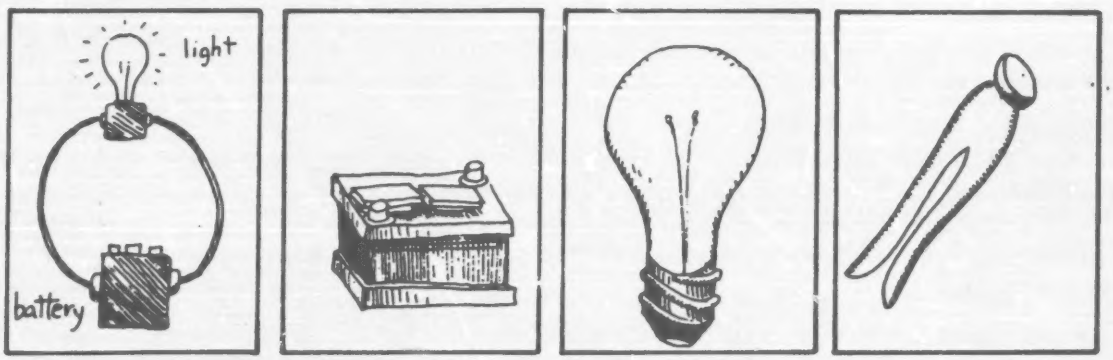
III _____

I. DIRECTIONS: Read each word. Choose the picture that means the same as the word. Put a big "X" on the picture that means the same as the word.

1. needle

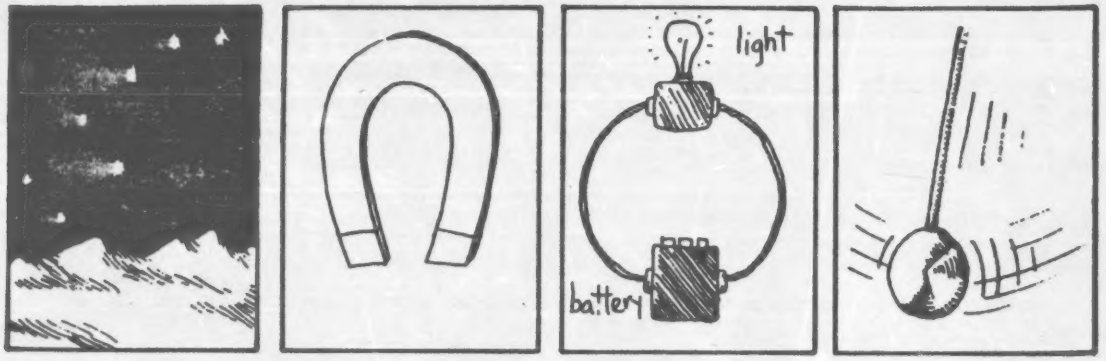
A B C D

2. circuit



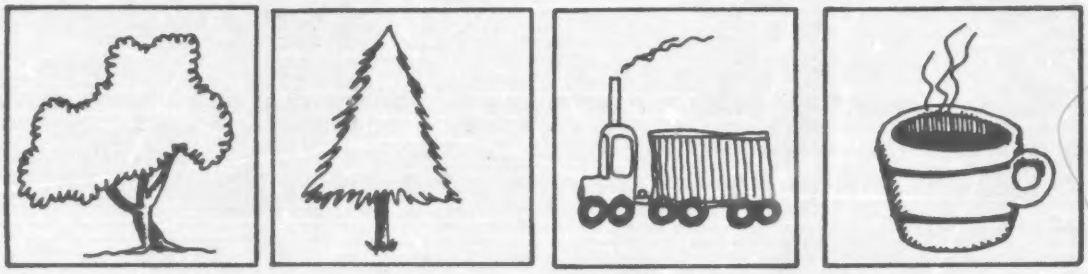
A B C D

3. constellation



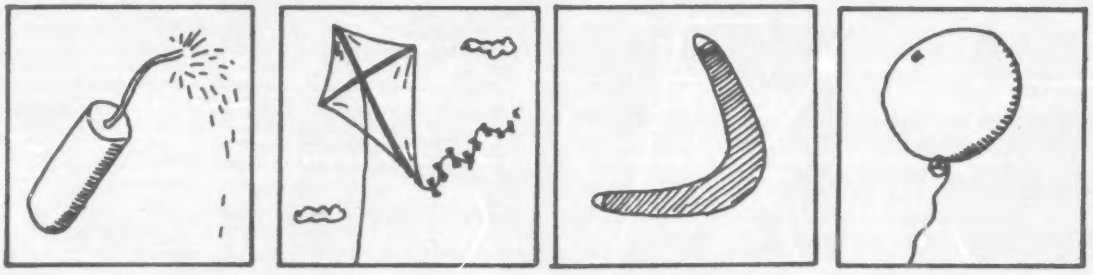
A B C D

4. symmetry



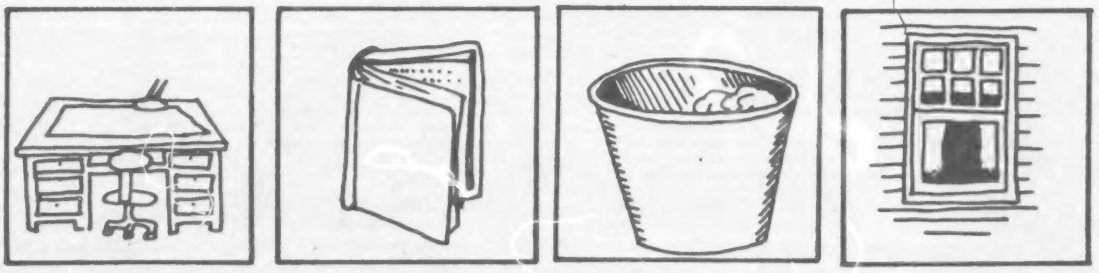
A B C D

5. boomerang



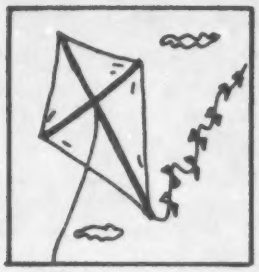
A B C D

6. circular



A B C D

7. knot

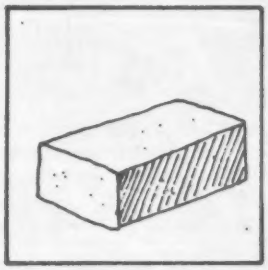

A

B

C

D

8. candle

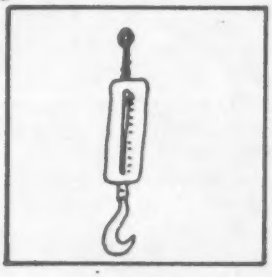

A

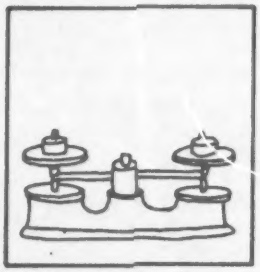
B

C

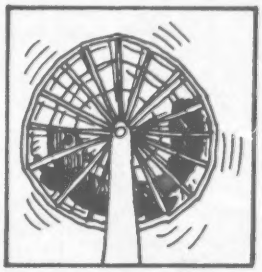
D

9. spring scale


A


B

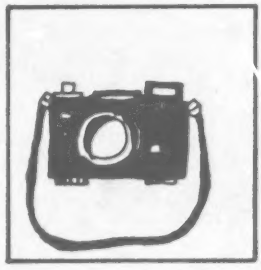
C


D

10. compass

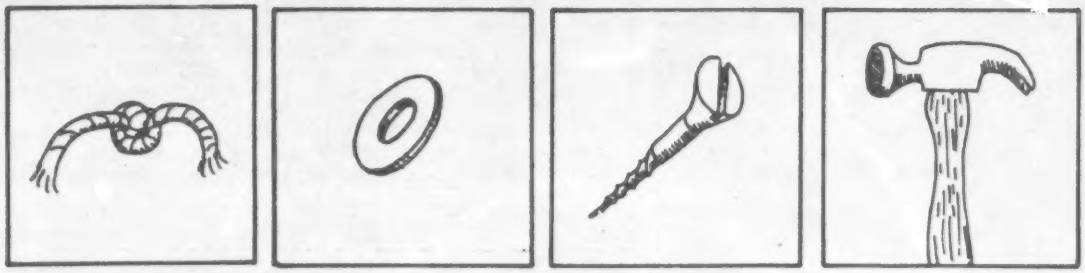
A

B


C

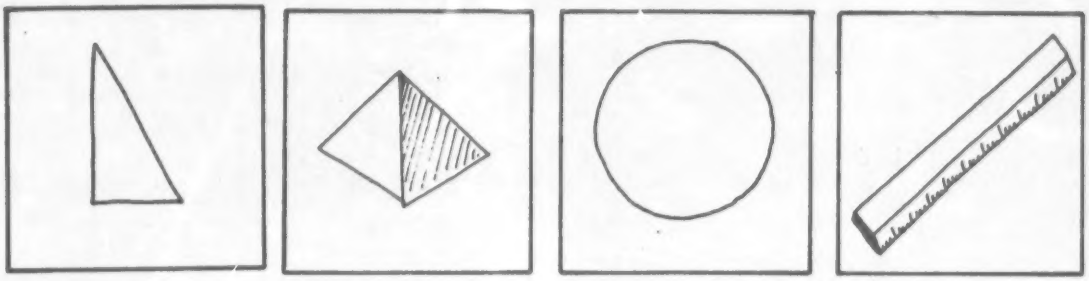
D

11. washer



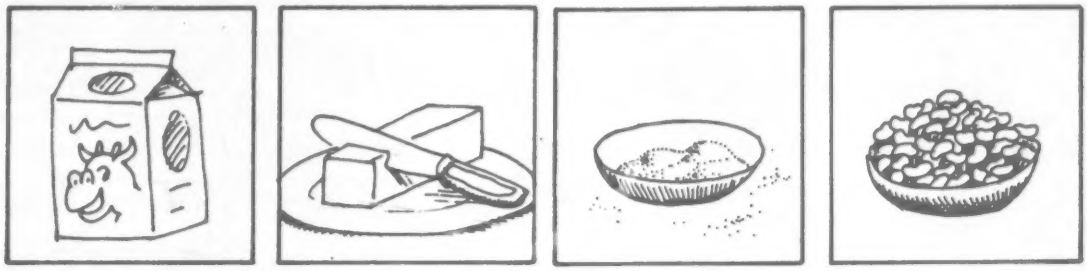
A B C D

12. polyshape



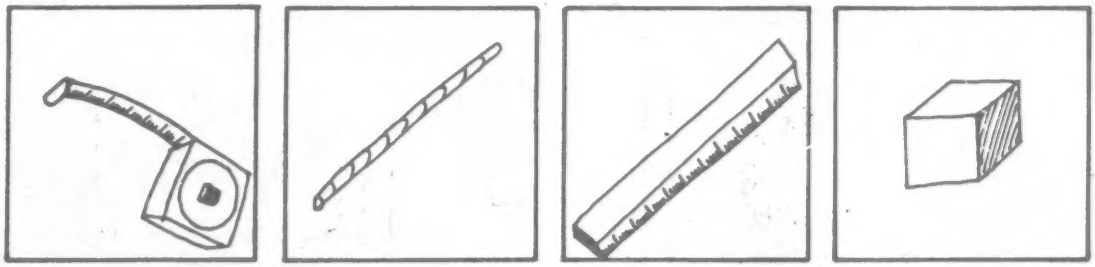
A B C D

13. powder



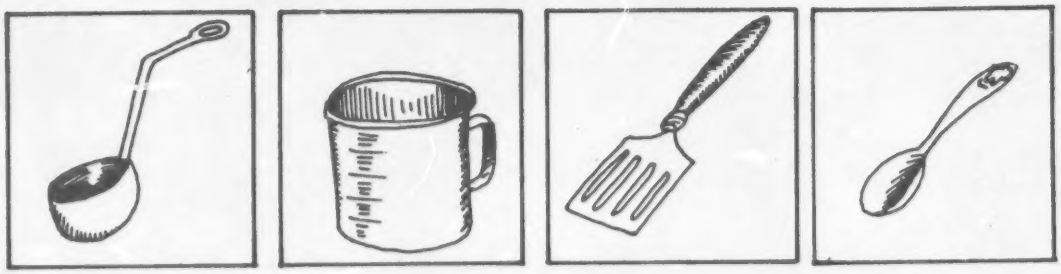
A B C D

14. flexible



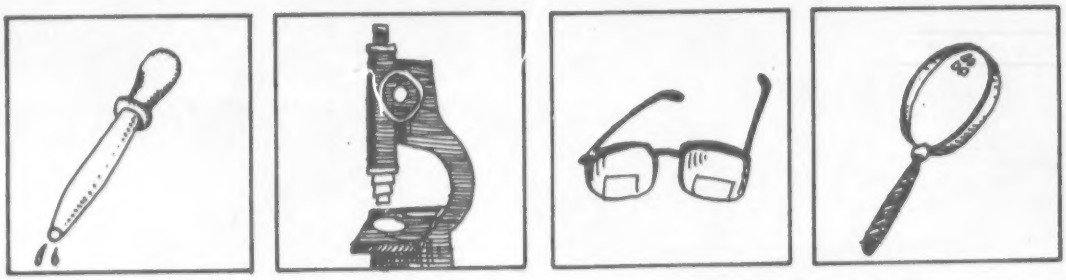
A B C D

15. teaspoon



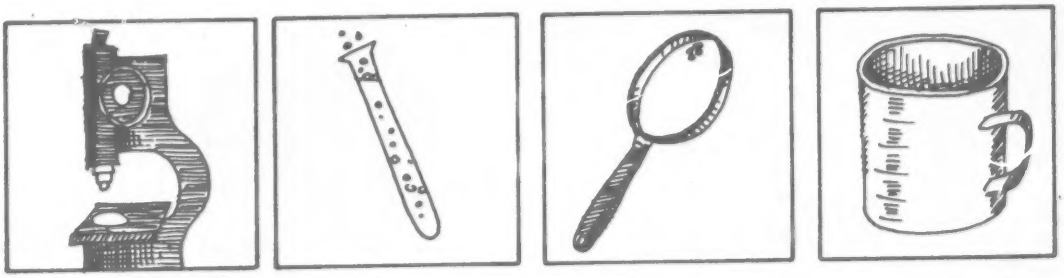
A B C D

16. eyedropper



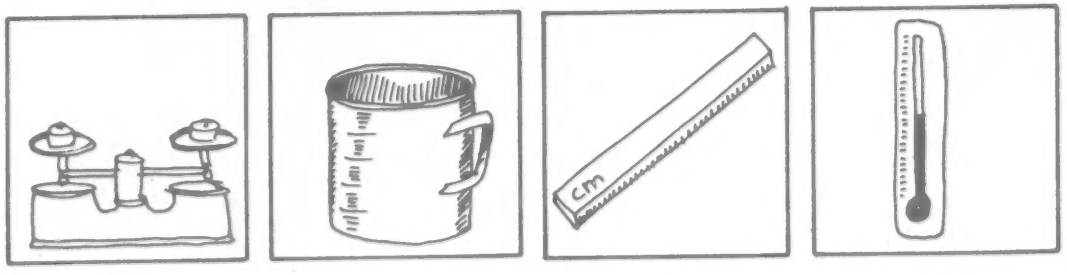
A B C D

17. test tube



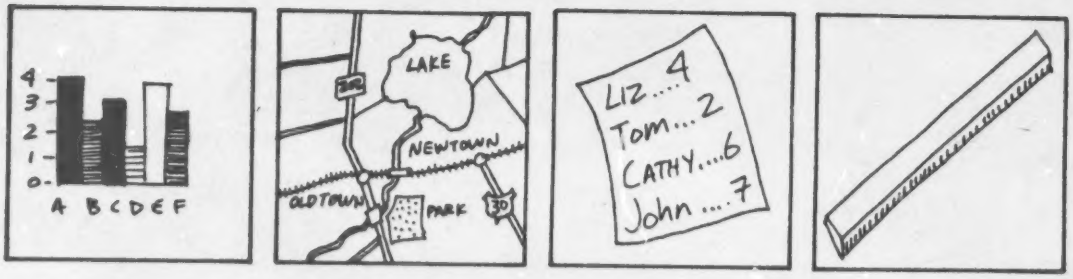
A B C D

18. ruler



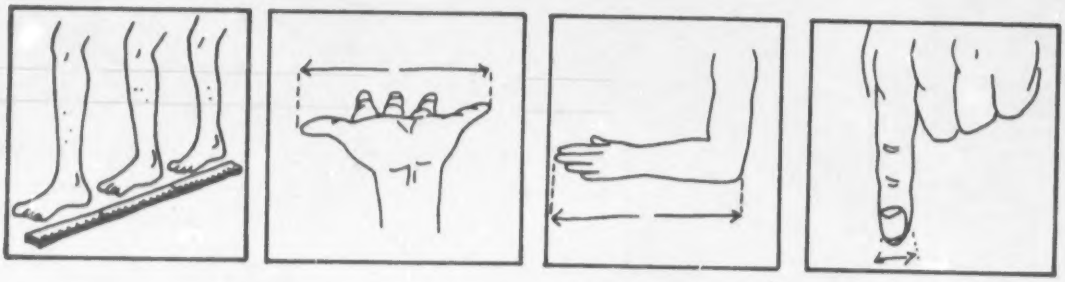
A B C D

19. graph



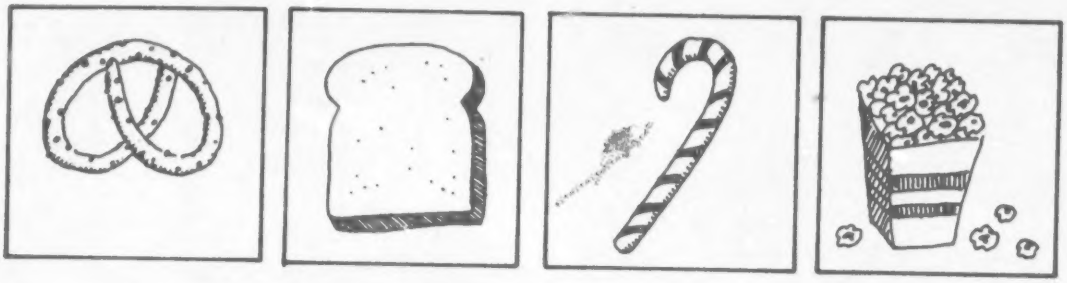
A B C D

20. span



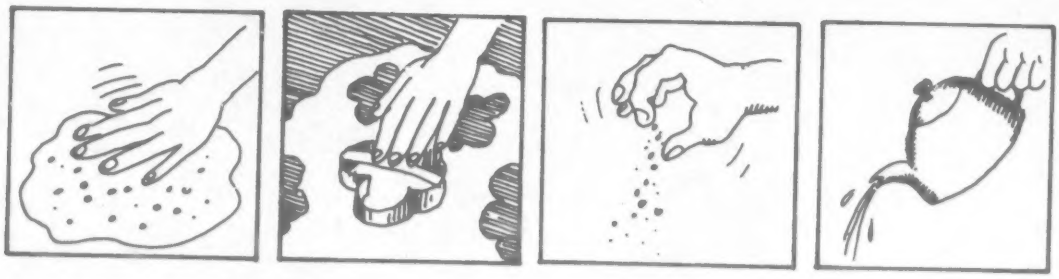
A B C D

21. pretzel



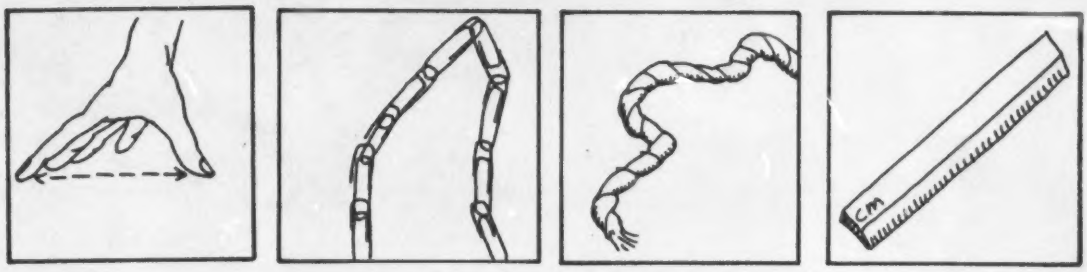
A B C D

22. sprinkle



A B C D

23. chain

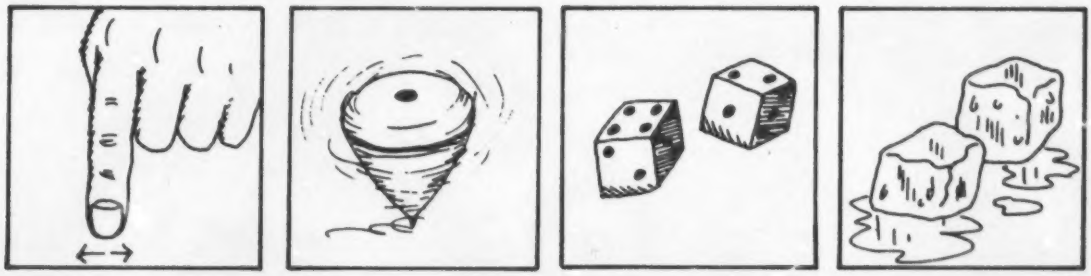


A B C D

24. slice

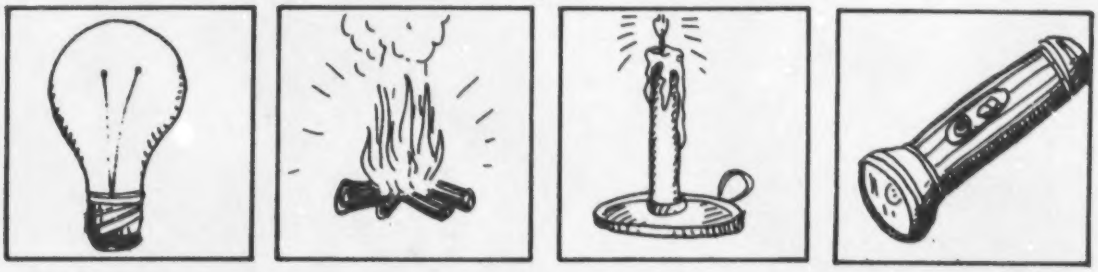
A B C D

25. dice



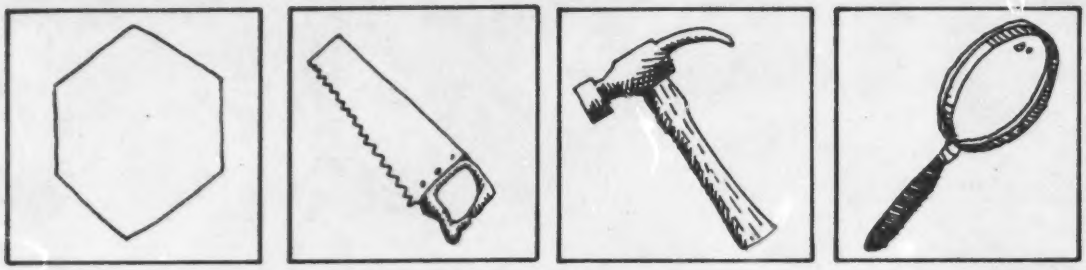
A B C D

26. flashlight



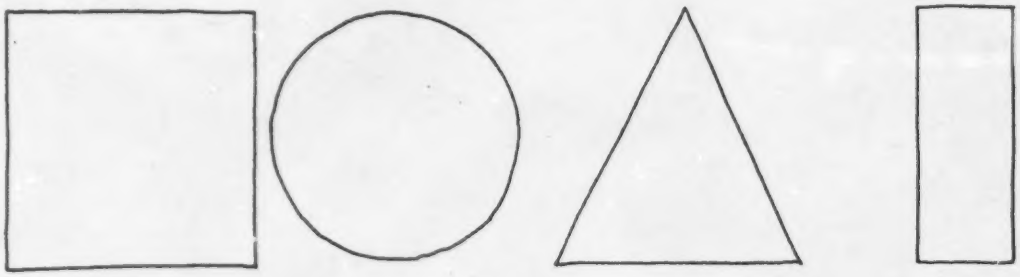
A B C D

27. hammer



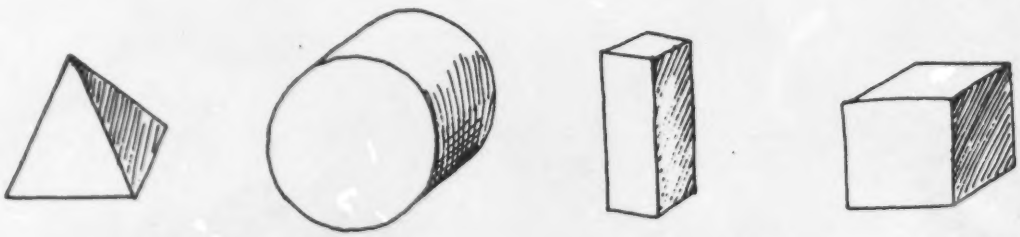
A B C D

28. square



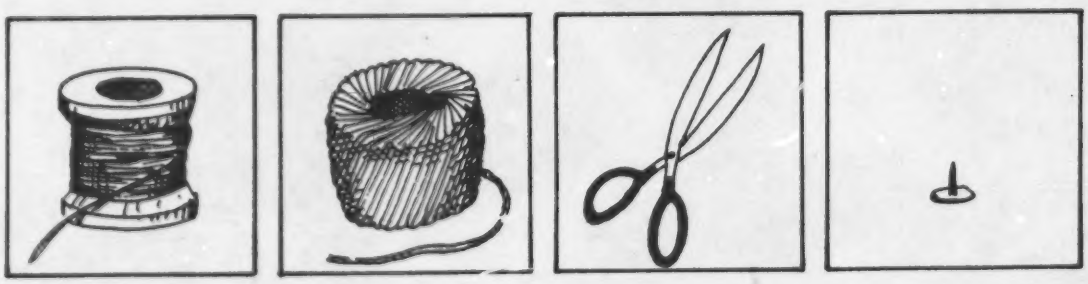
A B C D

29. cube



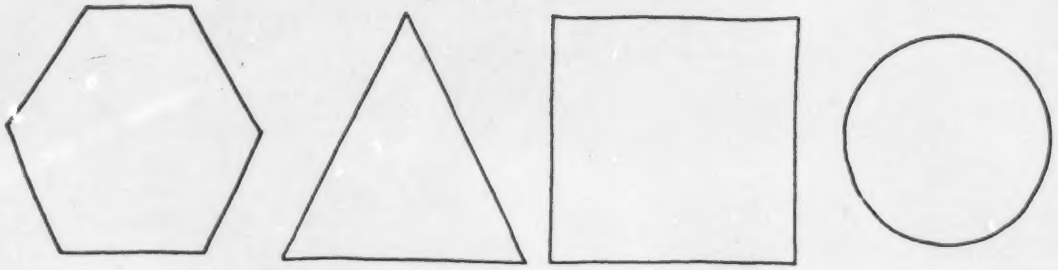
A B C D

30. thread



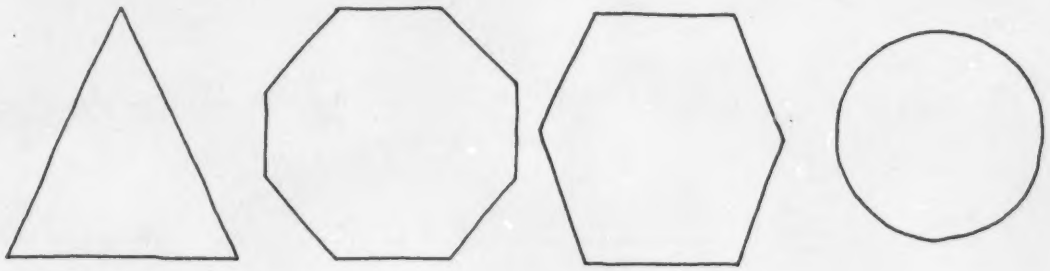
A B C D

31. triangle



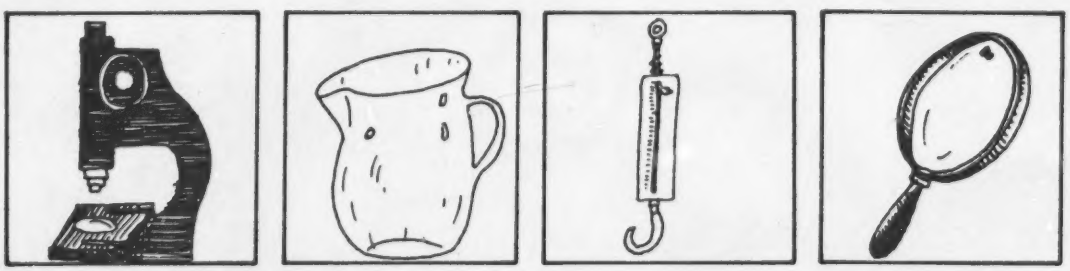
A B C D

32. hexagon



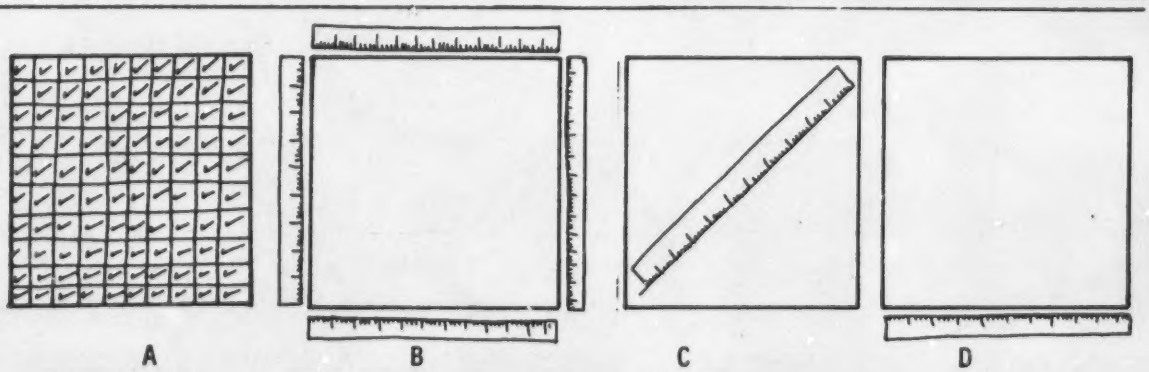
A B C D

33. magnifying glass



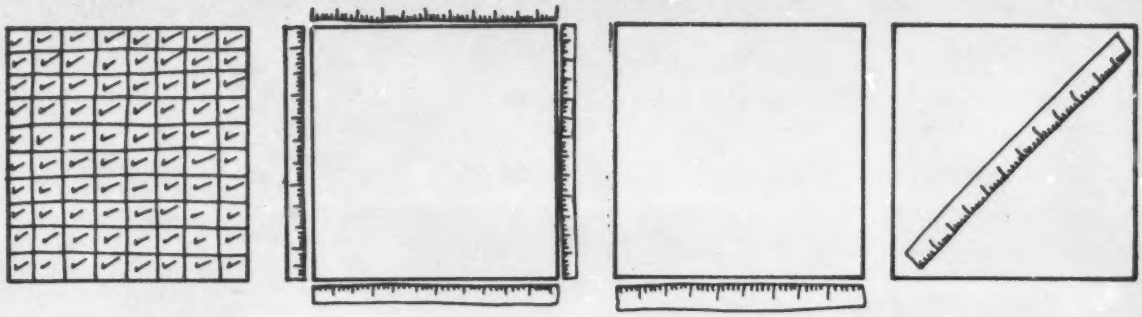
A B C D

34. perimeter



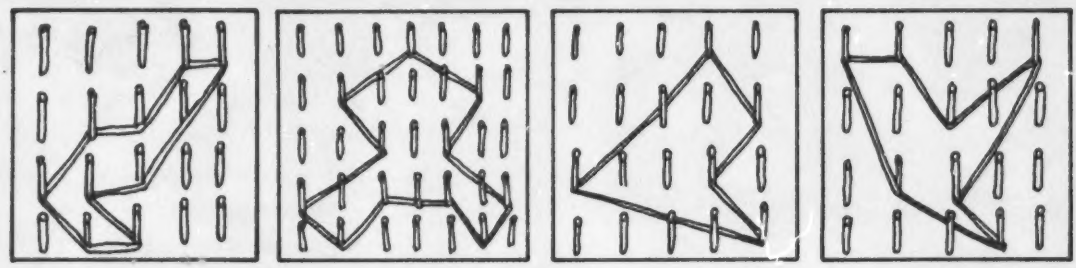
A B C D

35. area



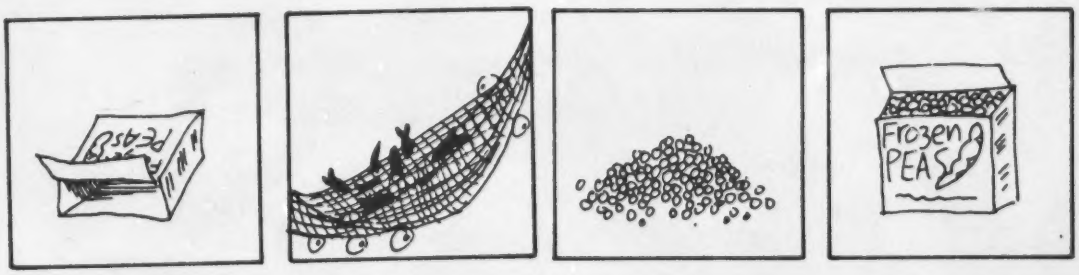
A B C D

36. symmetry



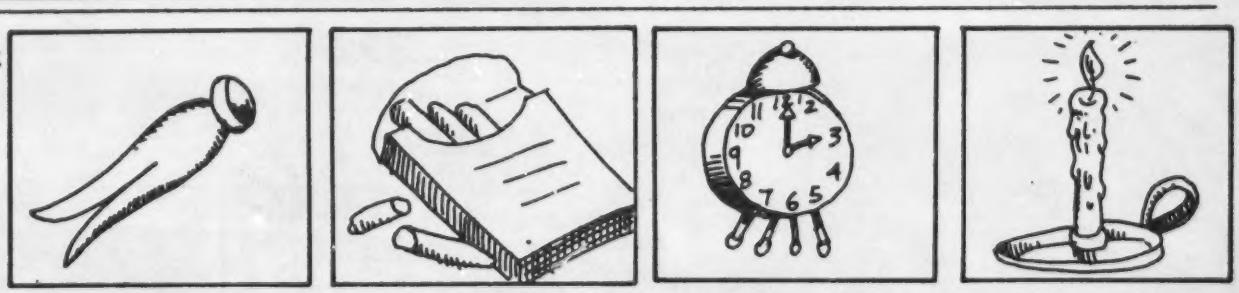
A B C D

37. net weight



A B C D

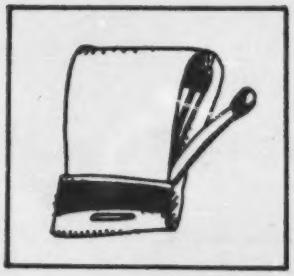
38. clock



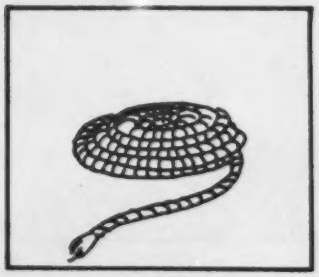
A B C D

39. flame

A



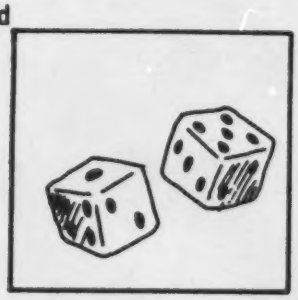
B



C

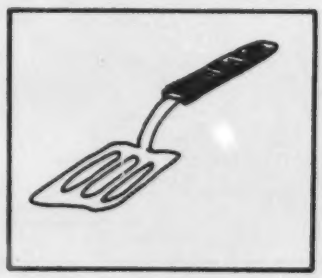
D

40. round

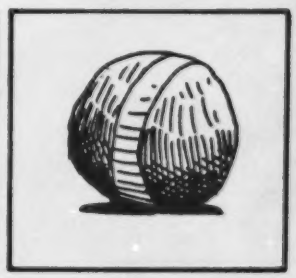


A

B



C



D

STOP

DIRECTIONS: Read each sentence. Choose the word that should finish the sentence.

1. Milliliters are useful for measuring _____.

   A. bugs

   B. milk

   C. your height

   D. your weight

2. To find your mass you should use a _____.

   A. mirror

   B. ruler

   C. scale

   D. measuring cup

3. Ships are able to float in the ocean because of _____.

   A. mass

   B. salt

   C. magnification

   D. surface tension

4. It takes about 1 second to _____.

   A. eat breakfast

   B. play baseball

   C. close your eyes

   D. brush your teeth

5. Jerry said, "This book's mass is 710 grams." Mass means _____.

   A. height

   B. length

   C. weight

   D. volume

6. Which of the following is a liquid?

   A. dough

   B. milk

   C. salt

   D. measuring cup

7. Cecilia is playing with a magnet. She is trying to find out what it will pick up. Which one of the following things will magnets pick up?

   A. paper

   B. socks

   C. paper clip

   D. rubber band

8. Carol liked to make jewelry. Her mother gave her some beads for Christmas. Carol decided to count the beads. She put them in groups of ten. Carol discovered she has 63 beads. How many groups of ten are in 63?

   A. 3

   B. 6

   C. 9

   D. 10

9. Tom is making a peanut butter and jelly sandwich for lunch. He is putting peanut butter on the bread. To make sure the peanut butter is all over the bread Tom is trying to _____ it.

A. float

B. shake

C. spread

D. trace

---

10. Tony's teacher told him the paint needed dilution. What should Tony do?

A. add salt

B. add water

C. heat the paint

D. stir the paint

---

11. Which unit of measurement should you use to measure your height?

A. meters

B. decimeters

C. centimeters

D. millimeters

---

12. The length of a fly should be measured in _____.

A. grams

B. meters

C. milligrams

D. millimeters

---

13. You should use millimeters to measure _____?

A. your height

B. your weight

C. the length of your desk

D. the length of your little fingernail

---

14. What should you do to concentrated juice before you drink it?

A. cook it

B. add lemon

C. add water

D. freeze it

---

15. John guessed that his foot was six centimeters long. John's guess is _____.

A. a test

B. an estimate

C. an experiment

D. a measurement

---

16. Jay measured the length of his pencil. It was ten centimeters long. Ten centimeters is the _____ length of the pencil.

A. actual

B. guessed

C. pretend

D. estimated

---

17. Jill thought she was eighty-seven centimeters tall. When her friend measured her, she told Jill that she was really ninety centimeters tall. Ninety centimeters is Jill's _____ height.

A. actual

B. guessed

C. pretend

D. estimated

---

18. Liz wanted to know how long her hand was. Mary measured Liz's hand from the tip of her middle finger to her wrist. Mary measured the _____ of Liz's hand.

A. width

B. height

C. length

D. thickness

---

19. Jerry wanted to know who was the tallest person in his class. He measured the five people he thought were the tallest and recorded their heights. What does "record" mean?

A. add

B. write

C. guess

D. estimate

---

20. Ann liked to breathe on the car windows. Then she could draw pictures on them with her fingers. What was Ann putting on the windows?

A. gas

B. paper

C. crayons

D. moisture

---

21. Joan and Mary each measured the length of the teacher's desk. Mary said it was eighty-seven centimeters. Joan said it was eighty-three centimeters. Mary and Joan cannot both be right. The girl who is right probably made a _____ measurement.

A. wrong

B. estimate

C. accurate

D. opposite

---

22. Ms. Brown wanted to buy carpet for her bedroom. She needs to decide how much to buy. What will Ms. Brown need to find out?

A. the area of the room

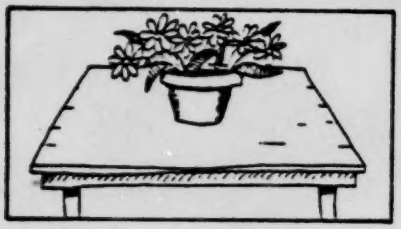
B. the perimeter of the room

C. the height of the room

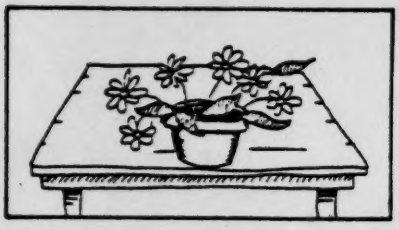
D. the volume of the room

Go on to the next page.

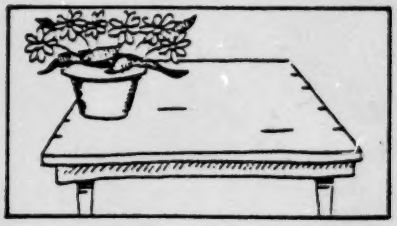
23. Which picture shows a table with a pot of flowers in the <u>center</u> of the table?



A

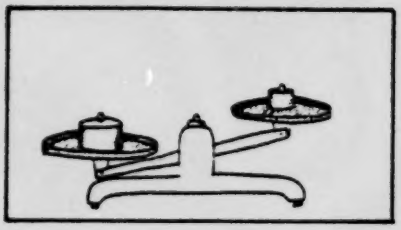


B

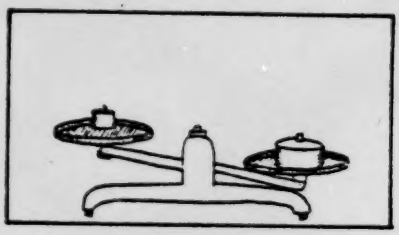


C

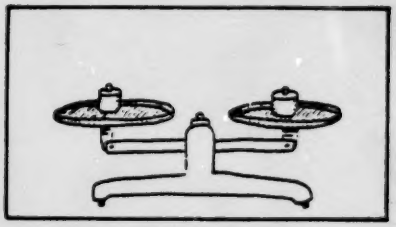
24. Which scale shows <u>balance</u>?



A

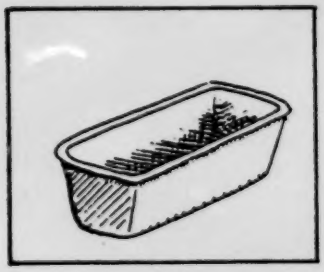


B



C

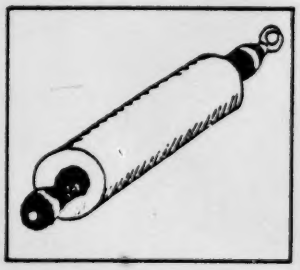
25. What should you use to knead dough?



A

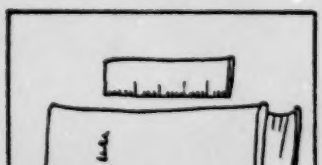
B

C

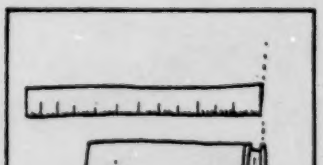


D

26. Which picture shows you how to make an <u>accurate</u> measurement?



A



B

C

D

27.

These liquids are all _____?

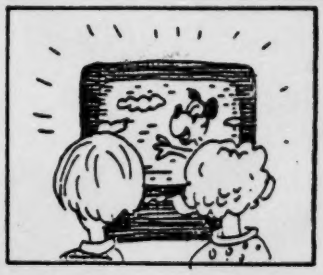
A. acid
B. base
C. neutral
D. poison

28.

A

B

C



D

Which of the above activities takes about <u>one</u> <u>minute</u> to do?
(Circle the correct letter below)

A.
B.
C.
D.

Go on to the next page.

DIRECTIONS: Look at the three pictures in order from left to right.
Choose the word that best describes what is happening.
Circle the letter next to your answer.

29.

Which word tells what is happening to the ball?

A. soak
B. bounce
C. arrange
D. flatten

30.

The last picture shows the _____ of Jim's work.

A. pattern
B. results
C. tangram
D. constellation

31.

What word tells what is happening?

A. boil
B. expand
C. dissolve
D. concentrate

32.

What is happening to the balloon?

A. It is expanding
B. It is condensing
C. It is being measured
D. It is being estimated.

33.

The ice cream bar is:

A. boiling
B. melting
C. pinching
D. expanding

Go on to the next page.

DIRECTIONS: Use the pictures to help you answer the questions.
Circle the letter next to your answer.

34. What do we call these things?

A. experiment
B. measurement
C. ingredients
D. carbon dioxide

35.

The buildings in the picture are making _____ on the sidewalk.

A. shadows
B. hexagons
C. tangrams
D. perimeters

36. Jack and Mary are looking for a hidden treasure. The paper they are looking at is probably a:

A. map
B. key
C. graph
D. dictionary

37. What is the pot of water putting in the air?

A. acid
B. crystal
C. moisture
D. negatives

38. In the picture Judy is watching the goldfish to see if they ever touch each other. Another words for "watch" is:

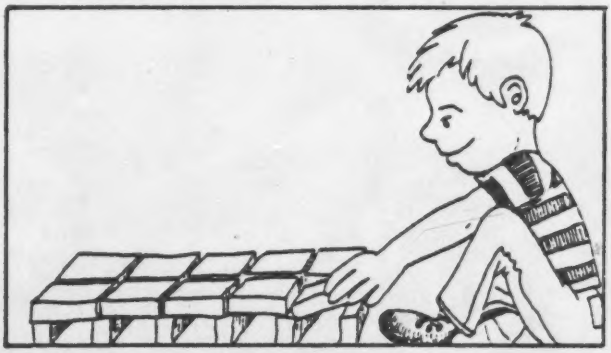
A. occupy
B. record
C. reduce
D. observe

39. Joe wants to know how caterpillars turn into butterflies. He has put a caterpillar in a jar and will watch it as it changes. How will Joe learn about the caterpillar?

A. He will shape it.
B. He will observe it.
C. He will estimate it.
D. He will crystalize it.

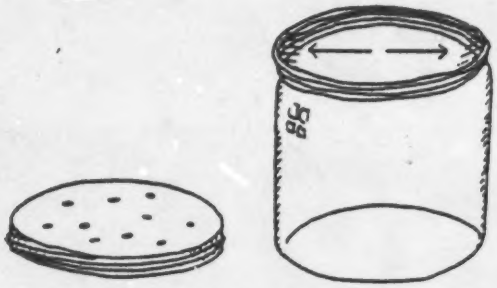
40. Tony built a bridge out of blocks. It was 5 blocks long and 2 blocks wide. We call these numbers the _____ of the bridge.

A. height
B. symmetry
C. materials
D. dimensions



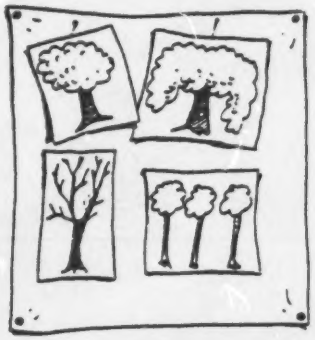
41. Barbara found a large grasshopper. She is not sure if the opening of her jar is large enough for the grasshopper to fit inthe jar. To find out if the grasshopper can fit in the jar, Barbara will need to measure the _____ of the jar.

A. height
B. length
C. diameter
D. perimeter



42. Julie had drawn several pictures of trees. She decided to glue all her pictures on one large piece of cardboard. What was Julie making?

A. poster
B. pattern
C. pentagon
D. perimeter



43. What is Juan doing with the milk?

A. pouring it
B. predicting it
C. plotting it
D. peeling it

44. To make a shadow you must have _____.

A. light
B. shoes
C. the sun
D. a camera

45. The airplane is flying in a certain _____.

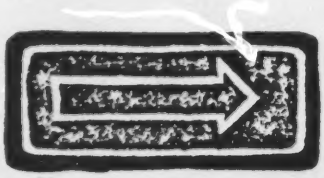
A. shadow
B. distance
C. solution
D. direction

46. Mr. Galvez is taking a picture of his class. Unfortunately, the camera is not working. Which of the following might Mr. Galvez's camera need?

A. film
B. tape
C. crystals
D. negatives

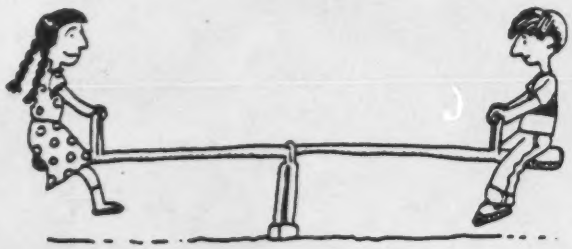
47. The arrow is pointing in a certain _____.

A. shadow
B. distance
C. solution
D. direction



48. What is the thing in the middle of the seesaw that makes it balance called?

A. circuit
B. fulcrum
C. insulation
D. magnification



49. When we say, "Leaves grow up and roots grow down," we are saying they each grow in a certain _____.

A. shadow
B. distance
C. solution
D. direction

50. Tom is pouring himself a glass of soda pop (such as coke). It looks like he poured too much. We might say, "The drink has _____."

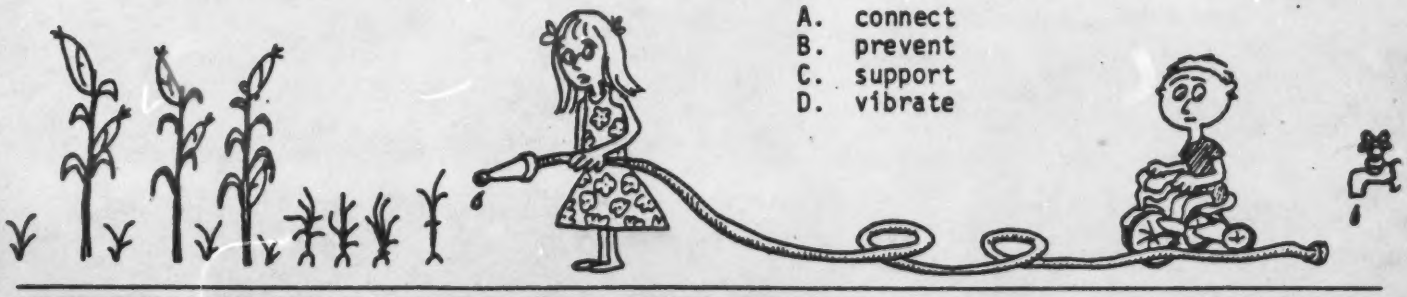
A. floated
B. reflected
C. separated
D. overflowed

51. Jill's grandmother was having trouble reading the newspaper. She said the letters were so small she could not see them. To make the letters look larger Jill's grandmother needs glasses which:

A. trace
B. magnify
C. reflect
D. contract

52. Judy's vegetable garden needs water. She got the end of the hose and took it to the garden. She asked her brother to _____ the other end of the hose to the faucet.

A. connect
B. prevent
C. support
D. vibrate



53. Jose was playing with a rubberband. He pulled on the rubberband and it make a sound. The sound was caused by a _____.

A. degree
B. balance
C. swallow
D. vibration

54. Susan and Sandra were playing together. Susan's mother had an idea of something to do. She mixed soap flakes and water together. Susan and Sandra used this mixture to blow soap bubbles. Another word for mixture is:

A. location
B. solution
C. vibration
D. prediction

55. The weatherman said it will probably rain tomorrow. He is making a:

A. quantity
B. prediction
C. structure
D. comparison

56. Joe's family went on a hike to a lake. Joe looked in the lake and saw himself. Sometimes lakes are like mirrors. They both:

A. break
B. focus
C. freeze
D. reflect

DIRECTIONS: Read each story. Answer the question.
Circle the letter next to your answer.

57. Sharon's plant was dying. She did not know why. She thought it might need more water or maybe it needed more light. First, Sharon decided to try watering the plant more often. After two weeks the plant was still sick. Sharon then decided to move the plant to a sunnier window. In a week the plant looked much better. To find out what was wrong with her plant, what did Sharon do?

A. a graph
B. a recipe
C. a measure
D. an experiment

58. Mr. Jacob's class was doing exercises every afternoon. Today he wanted to teach everyone a new exercise. To do this exercise everyone would need to find one other person to work with. Amy and Beth decided to work together. We would call them _____.

A. circular
B. partners
C. identical
D. scavengers

59. Jean and Susan decided to ride their bicycles to the drugstore. They met at Susan's house and talked about their bikes. Jean liked Susan's bicycle because it was red and had a horn. Jean's bike was blue and did not have a horn. Susan liked Jean's bike because it had a basket and a soft seat. What were the two girls doing with their bikes?

A. tracing them
B. comparing them
C. measuring them
D. diagraming them

60. Mr. Rodriguez needed to fix the roof over his house. He was going to have to buy a ladder to get up on the roof. Before he went to the store he went outside and looked at his house to see how tall it was. Mr. Rodriguez did not have a tape measure but he guessed that he would need to buy a twenty foot ladder. What do you think Mr. Rodriguez did?

A. record
B. measure
C. estimate
D. stretch

61. Joey's family got a new dog which they named Tippy. Joey wanted to keep Tippy in the house at night so he wouldn't be cold, but Joey's dad said the dog had to stay outside all the time. Joey decided to build a house for Tippy. His father gave him some wood and tools. The first thing Joey needed to do was decide how big the dog house would need to be for Tippy to fit inside of it. How should Joey do this?

A. measure Tippy
B. shorten Tippy
C. build the house around Tippy
D. build a house and hope it is large enough

62. After school Jill went over to Cecilia's house to play. When it came time for Jill to walk home, Cecilia's mother was worried that it would soon start raining. She decided it would be a good idea to let Jill wear Cecilia's raincoat to walk home in. How did Cecilia's mother decide that Jill and Cecilia were approximately the same size?

A. she outlined
B. she recorded
C. she estimated
D. she magnetized

---

63. Tom and Alfredo were making chocolate pudding. The directions on the box told them how much milk to use. Tom dumped the pudding in the bowl. What should Alfredo do before he puts the milk in the bowl?

A. heat it
B. drink it
C. weigh it
D. measure it

---

64. Ann needed a flashlight to see if her cat was under the house. When she tried to turn the flashlight on, it did not work. Ann was not sure what was wrong with the flashlight. Maybe it needed a new light, or maybe it needed new batteries. To find out, Ann first tried new batteries. The flashlight still did not work so Ann decided it must need a new light. To discover what was wrong with the flashlight, what did Ann do?

A. a graph
B. a recipe
C. a measure
D. an experiment

STOP.

No. _____ Nombre _____

Escuela _____ Niño_____ Niña_____

Grado _____ Condición_____

Edad _____

Maestro/a _____

LIBRITO PARA
DESCUBRIMIENTO

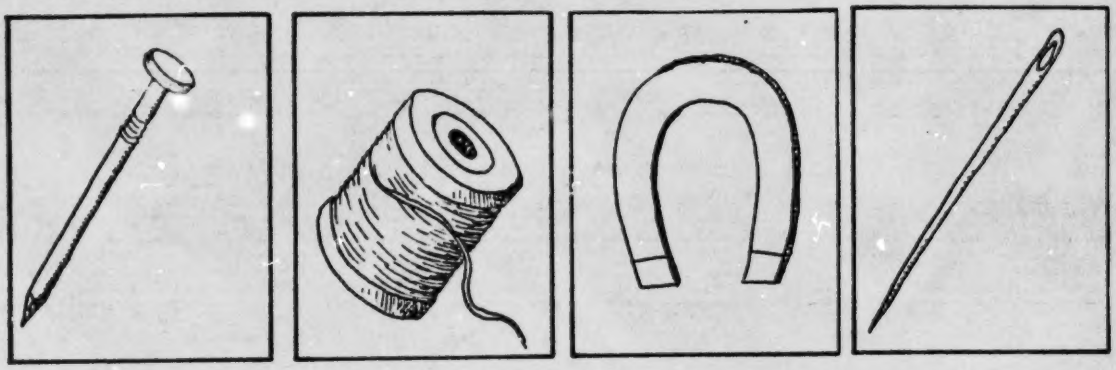
Parte I _____

II _____

III _____

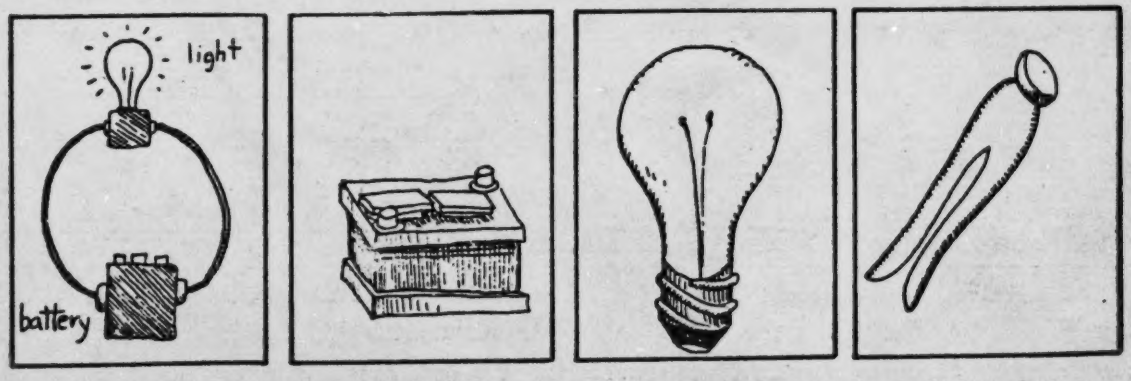
I. DIRECCIONES: Lee cada palabra. Escoje el dibujo que quiere decir lo mismo que la palabra. Pon una "X" grande en el dibujo que quiere decir lo mismo que la palabra.

1. la aguja



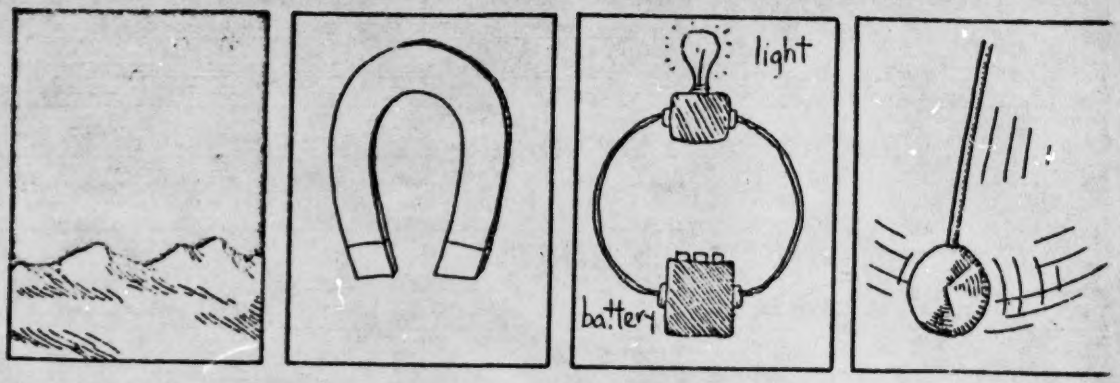
A B C D

2. el circuito



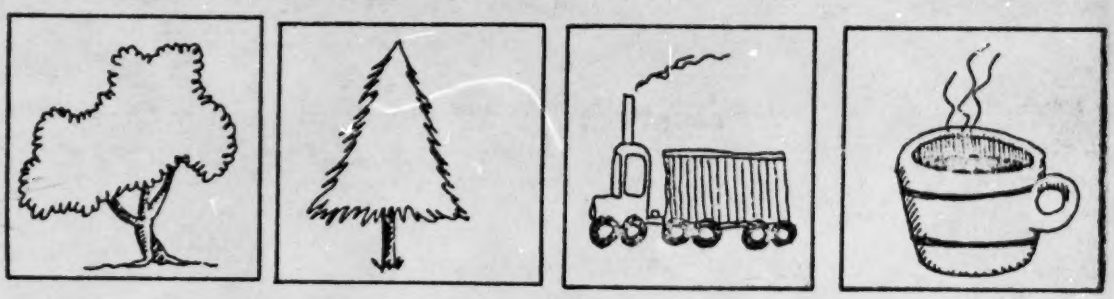
A B C D

3. la constelación



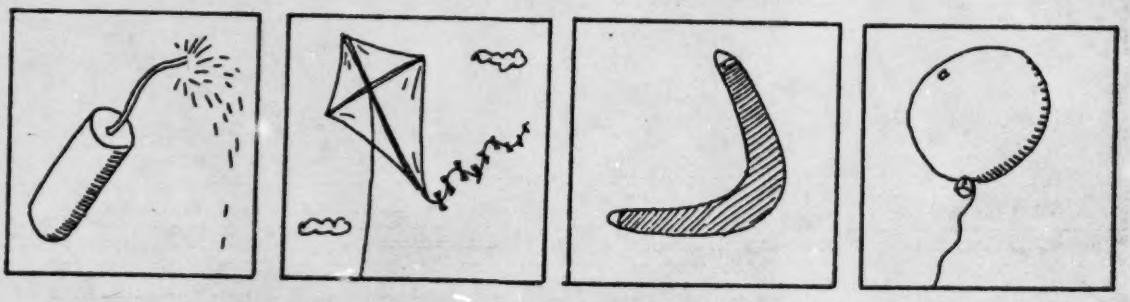
A B C D

4. la simetría



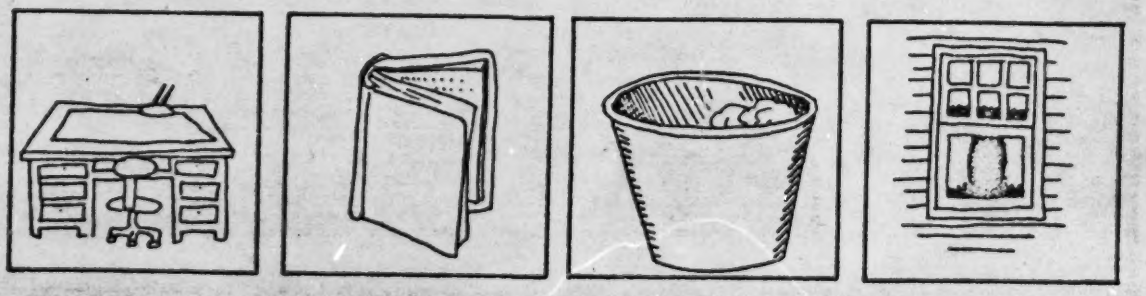
A B C D

5. el bumerang



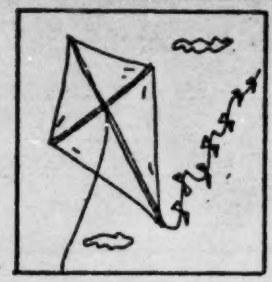
A B C D

6. circular



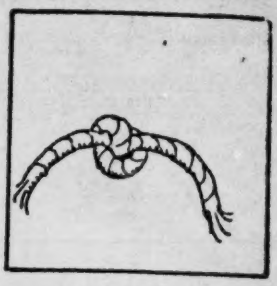
A B C D

7. el nudo

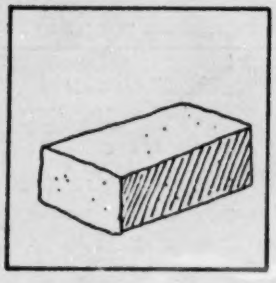

A

B

C


D

8. la vela


A

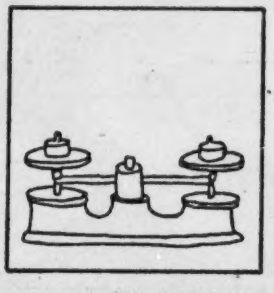
B

C

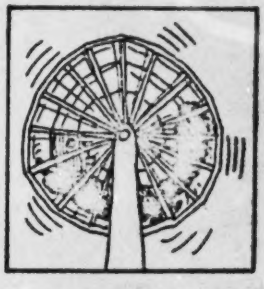
D

9. la báscula

A


B

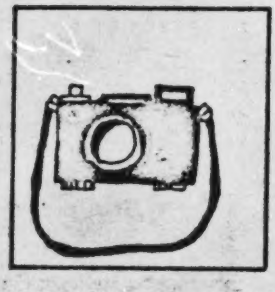
C


D

10. el compás

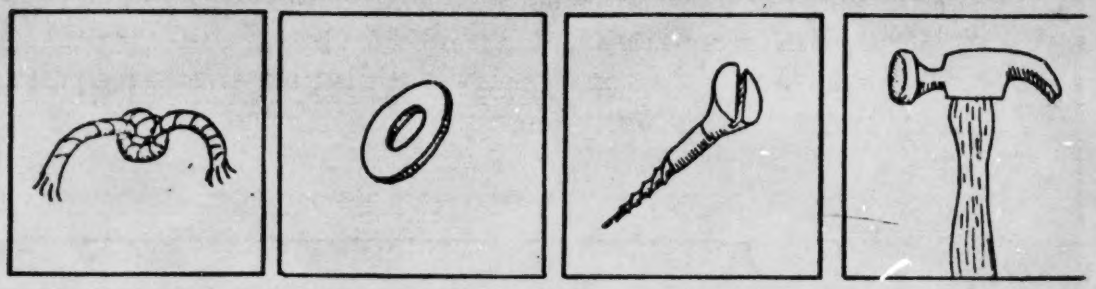
A

B


C

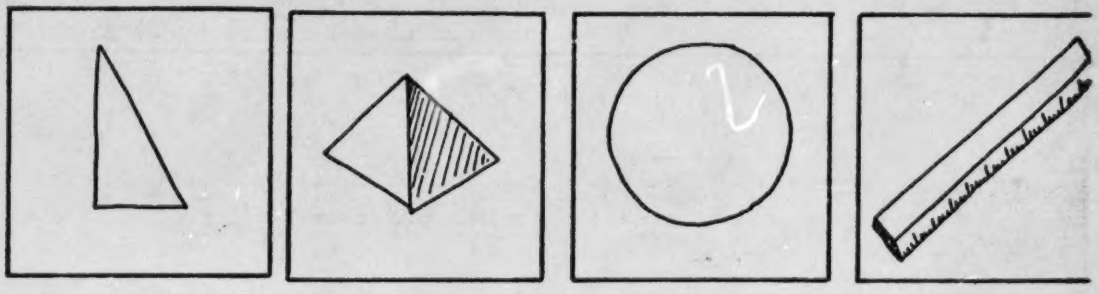
D

11. la arandela



A B C D

12. la poliforma

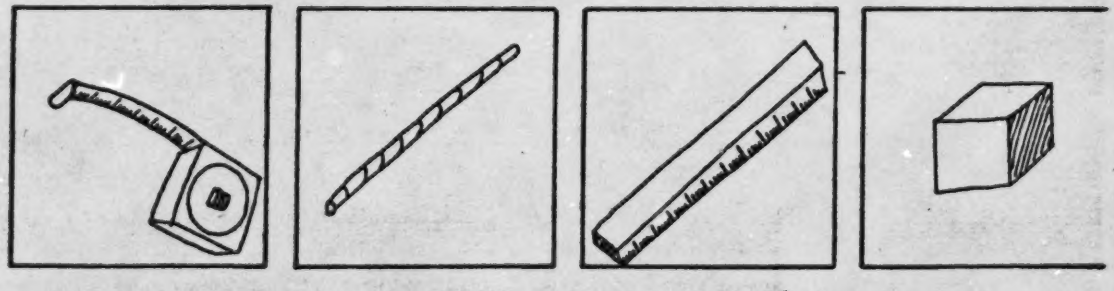


A B C D

13. el polvo

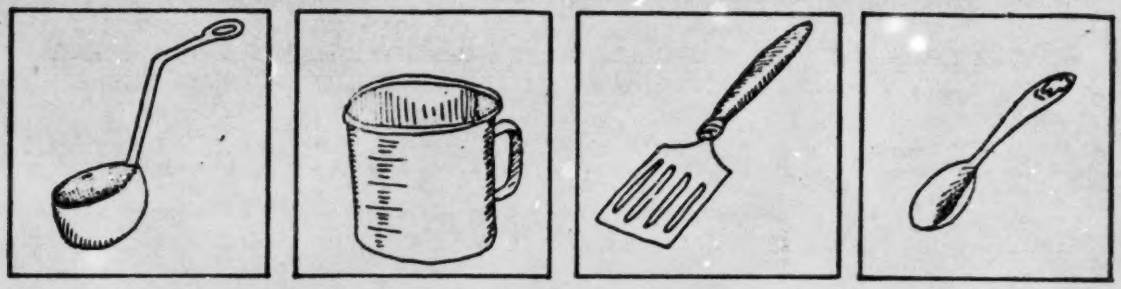
A B C D

14. flexible



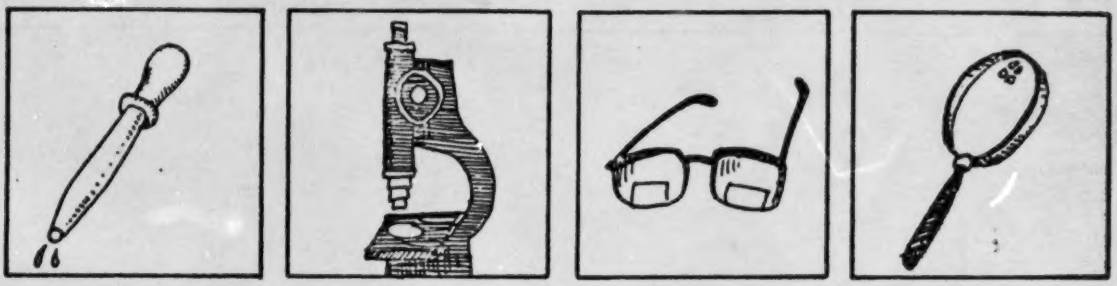
A B C D

15. la cucharita



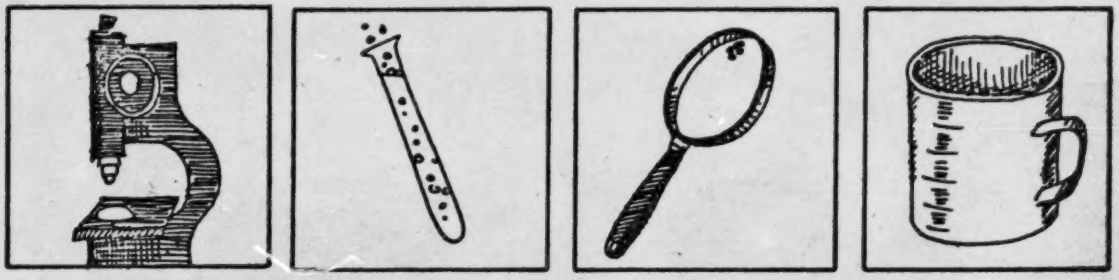
A B C D

16. el gotero



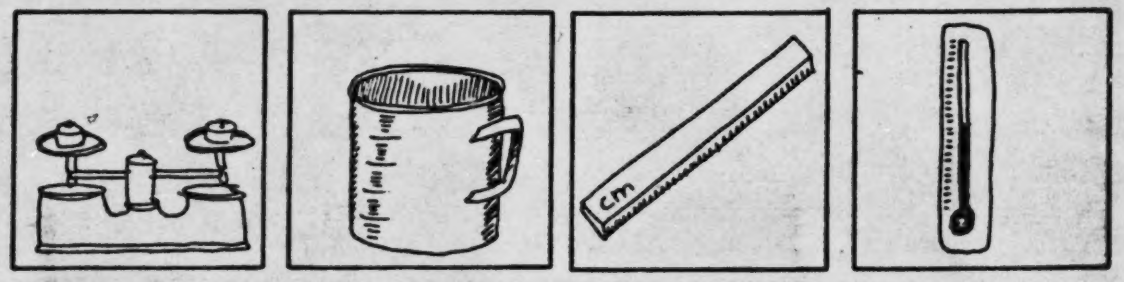
A B C D

17. la probeta



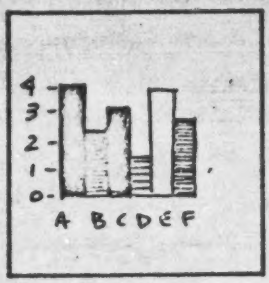
A B C D

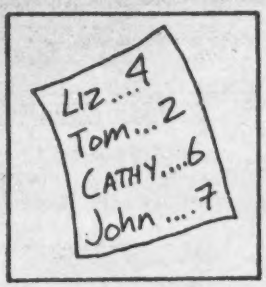
18. la regla

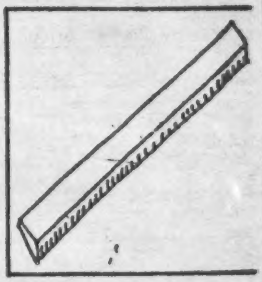


A B C D

19. la gráfica

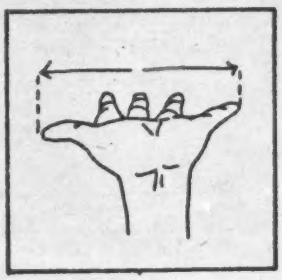






A B C D

20. una palma



A B C D

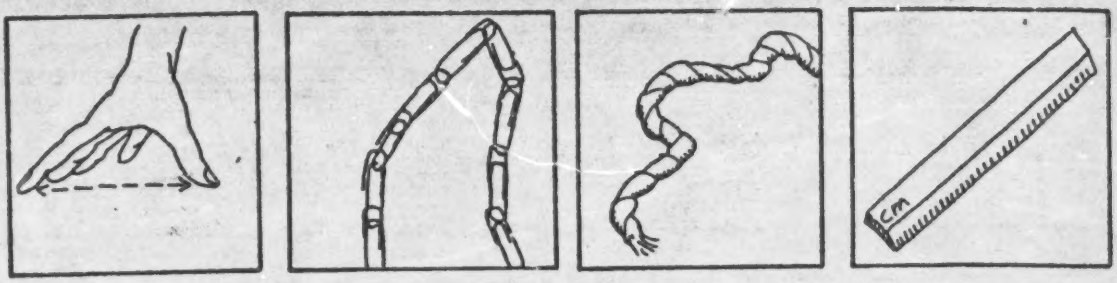
21. el pretzel

A B C D

22. salpicar

A B C D

23. la cadena

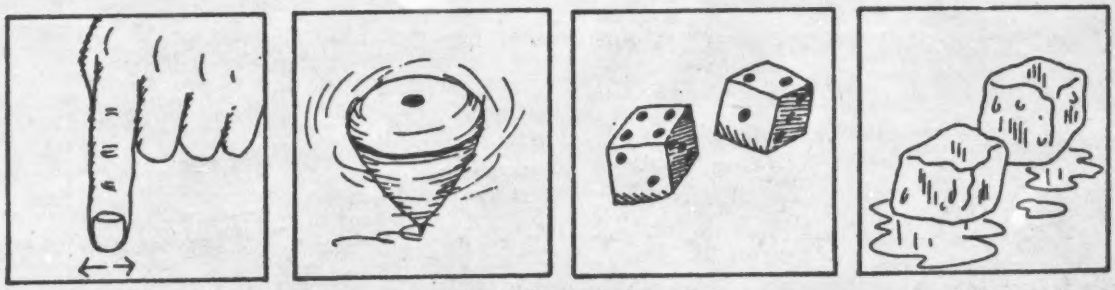


A B C D

24. la rodaja

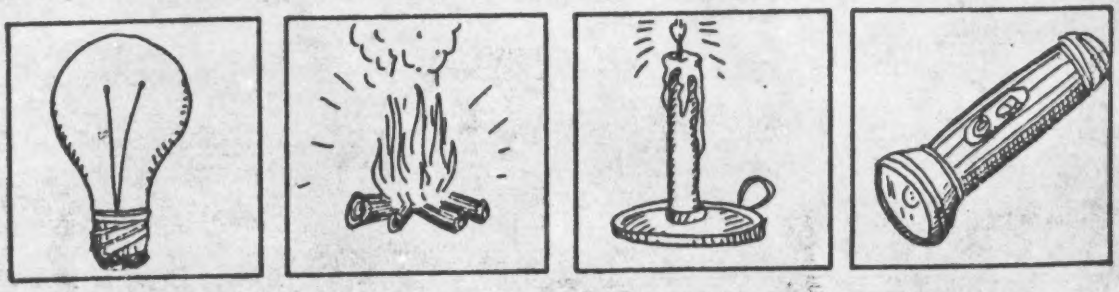
A B C D

25. el dado



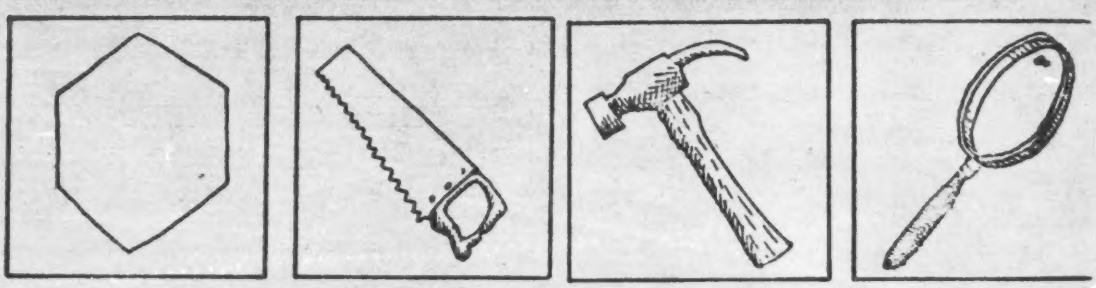
A B C D

26. la eléctrica



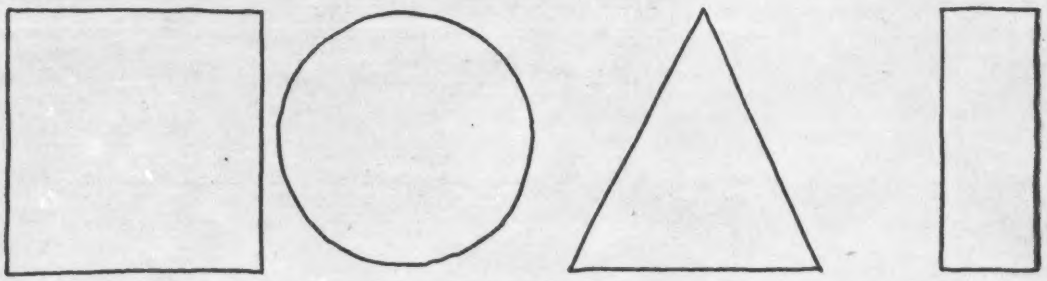
A B C D

27. el martillo



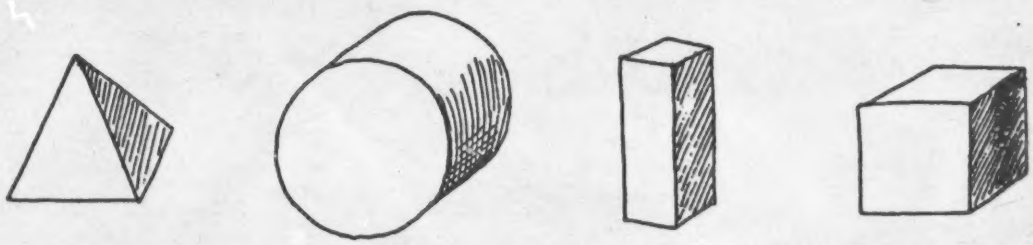
A B C D

28. el cuadrado



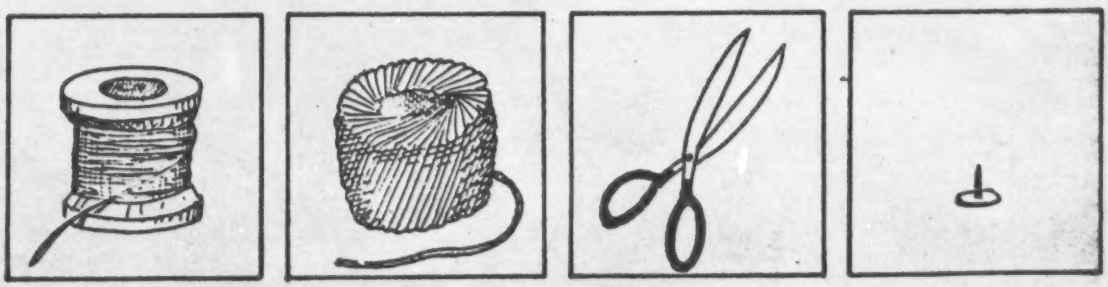
A B C D

29. el cubo



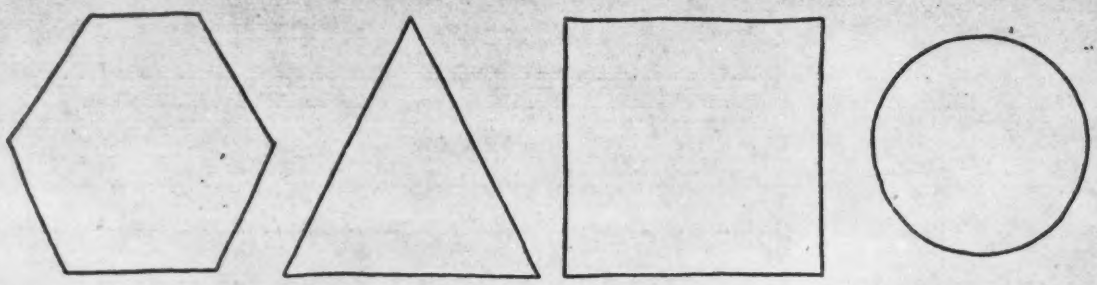
A B C D

30. el hilo



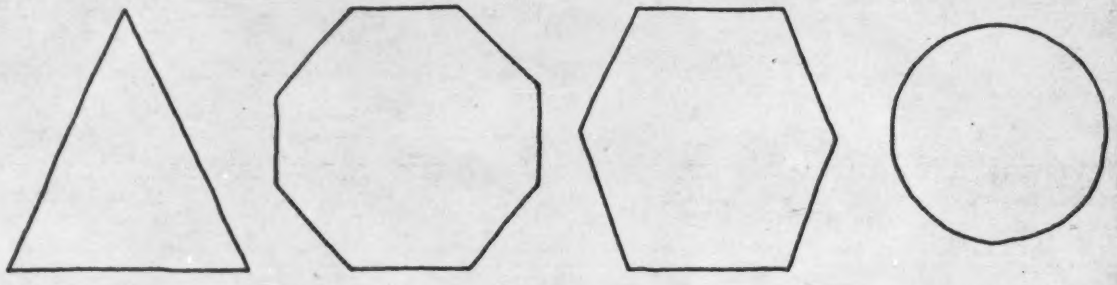
A B C D

31. el triángulo



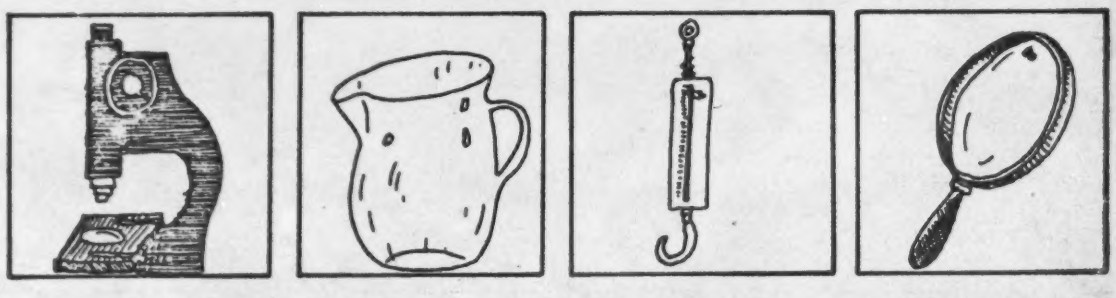
A B C D

32. el hexágono



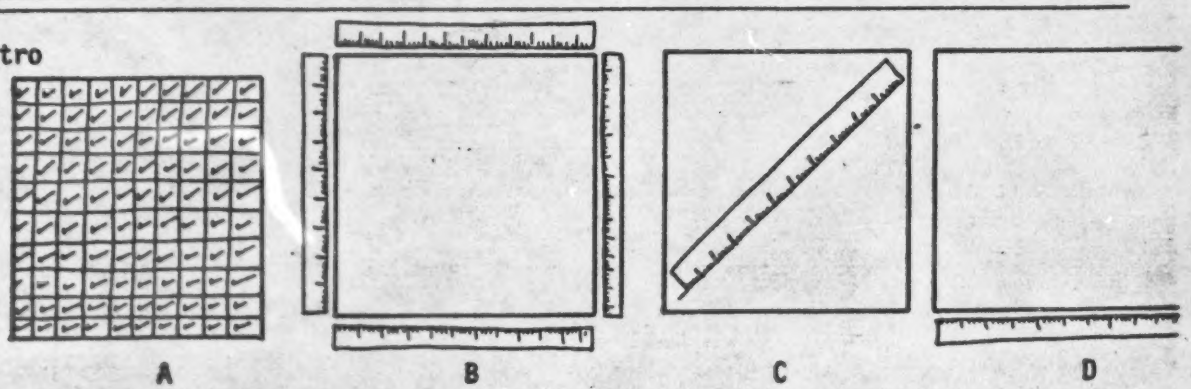
A B C D

33. la lupa



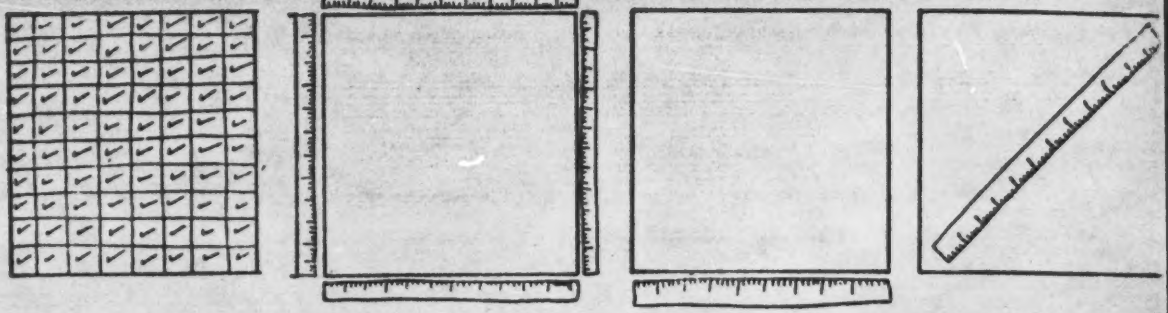
A B C D

34. el perímetro



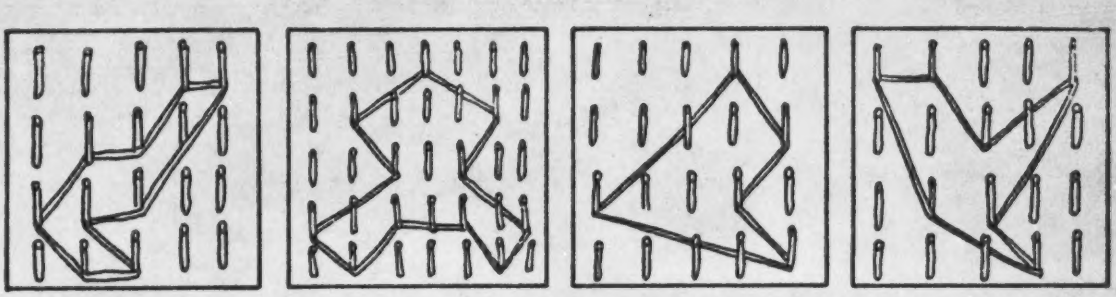
A B C D

35. el área



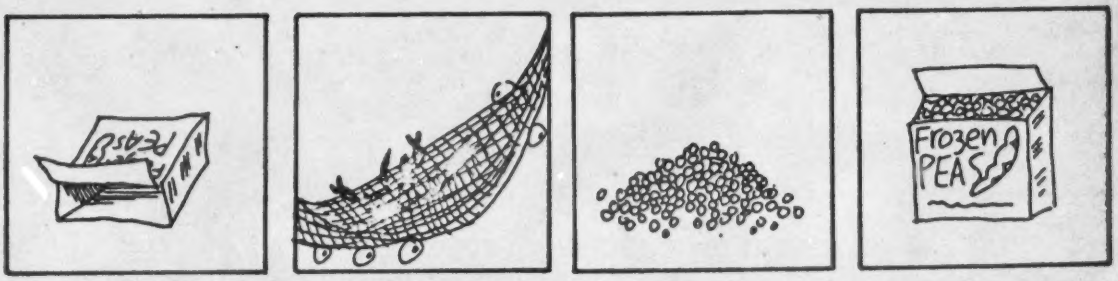
A B C D

36. la simetría



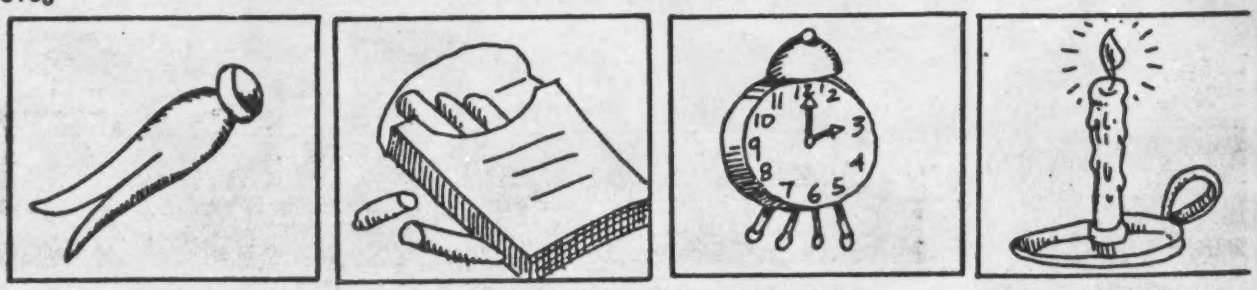
A B C D

37. el peso neto



A B C D

38. el reloj

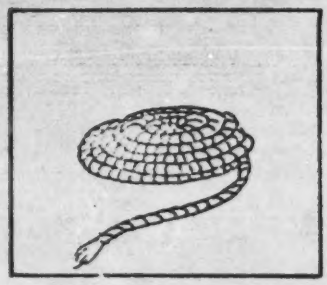


A B C D

39. la llama

A

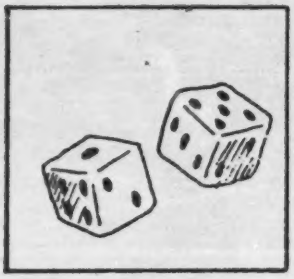
B



C

D

40. redondo



A

B

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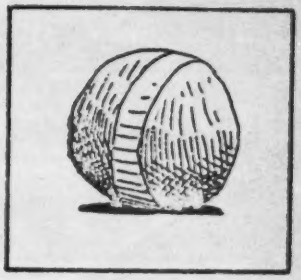


D

FIN DE LA SECCION 1

II. DIRECCIONES: Pon un círculo alrededor de la palabra o las palabras que mejor contesta la pregunta.

1. Los mililítros son útiles para medir _____.

   A. insectos
   B. la leche
   C. tu altura
   D. tu peso

2. Para encontrar tu masa, debes usar un/una _____.

   A. un espejo
   B. una regla
   C. una escala
   D. una taza de medidas

3. Es por _____ que los barcos pueden flotar en el mar.

   A. su masa
   B. la sal
   C. la magnificación
   D. la tensión de la superficie

4. Uno se tarda como un segundo en _____.

   A. desayunar
   B. jugar béisbol
   C. cerrar los ojos
   D. lavarse los dientes

5. Jerry dijo, "La masa de este libro es 710 gramos." Masa quiere decir _____.

   A. la altura
   B. lo largo
   C. el peso
   D. el volumen

6. De los siguientes, ¿cuál es un líquido?

   A. masa de harina
   B. la leche
   C. la sal
   D. una taza para medir

7. Cecilia está jugando con un imán. Quiere averiguar qué cosas levanta el imán. ¿Cuál (una) de las siguientes cosas levanta el imán?

   A. papel
   B. calcentines
   C. un sujetapapeles
   D. una banda elástica

8. A Carol le gusta hacer joyería. Para Navidad, su mamá le regaló unas cuentitas. Carol decidió contarlas. Las juntó en grupos de 10. En total ella contó que tenía 63. Cúantos grupos de 10 hay en 63?

   A. 3
   B. 6
   C. 9
   D. 10

9. Tom se está haciendo un sandwich de mantequilla de manf y de jalea para su almuerzo. Quiere que un lado del pan esté completamente cuberto con la mantequilla de manf. Tom tiene que _____.

A. flotarla

B. batirla

C. untarla

D. calcarla

---

10. La maestra de Tony le dijo que tenía que diluir la pintura. ¿Que debe hacer Tony?

A. agregarle sal

B. agregarle agua

C. calentar la pintura

D. revolver la pintura

---

11. ¿Qué unidad de medidas deberás usar para medir tu altura?

A. metros

B. decímetros

C. centímetros

D. milímetros

---

12. Lo largo de una mosca habría que medirlo en _____.

A. gramos

B. metros

C. miligramos

D. milímetros

---

13. Deberías de usar milímetros para medir _____.

A. tu altura

B. tu peso

C. lo largo de tu escritorio

D. lo largo de la uña de tu dedo chico

---

14. ¿Qué la haces al jugo concentrado antes de tomártelo?

A. cocinarlo

B. agregarle limón

C. agregarle agua

D. congelarlo

---

15. Juan adivinó que su pie medía seis centímetros. Su adivinanza la llamamos _____.

A. un examen

B. una estimación

C. un experimento

D. una medida

---

16. Jay midió lo largo de su lápiz. Medía 10 centímetros. 10 centímetros es el largo _____ del lápiz.

A. real

B. adivinado

C. aprendido

D. estimado

---

17. Jill pensó que medía 87 centímetros de altura. Cuando su amiga la medió, le dijo que en realidad medía 90 centímetros. La altura _____ de Jill son los 90 centímetros.

A. real

B. adivinada

C. fingida

D. estimada

---

18. Liz quería saber qué largo tenía su mano. Mary se la midió desde la punta de su tercer dedo, hasta la muñeca. Mary midió lo/la _____ de la mano de Liz.

A. ancho

B. alto

C. largo

D. grueso

---

19. Jerry quería saber quién era la persona más alta de su clase. Midió la altura de las cinco personas de su clase que él pensó podrían ser entre los más altos, y de allí registró las medidas. ¿Qué quiere decir "registrar"?

A. agregar

B. escribir

C. adivinar

D. hacer una estimación

---

20. A Ana le gusta dejar su aliento en las ventanas de los carros porque así puede hacer dibujitos con su dedo sobre la ventana. ¿Qué es los que estaba dejando el aliento de Ana sobre el vidrio de la ventana?

A. gas

B. papel

C. crayolas

D. la humedad

---

21. Juana y María midieron el largo del pupítre de la maestra. María le calculó 87 centímetros. Juana le calculó 83 centímetros. Es imposible que las dos tengan la medida correcta. La niña que tiene la razón, probablemente hizo una medida _____.

A. equivocada

B. estimada

C. exacta

D. opuesta

---

22. La Srta. Brown quería comprar una alfombra para su dormitorio. Tenía que decidir cúanto comprar. ¿Qué cosa tendrá que calcular la Srta. Brown?

A. el área de su cuarto

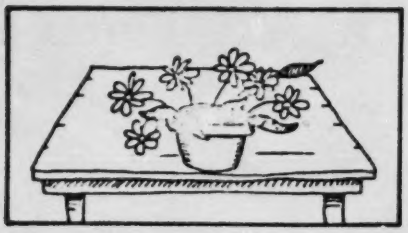
B. el perímetro de su cuarto

C. la altura de su cuarto

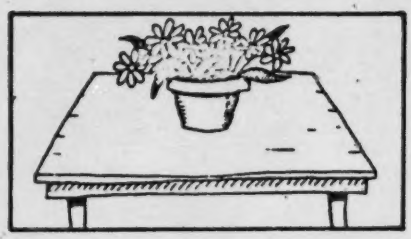
D. el volúmen de su cuarto

Sigue a la próxima página para continuar.

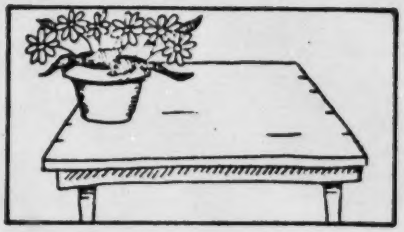
23. ¿En cuál de estos dibujos está la maceta en el centro de la mesa?



A

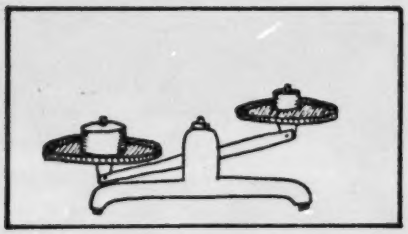


B

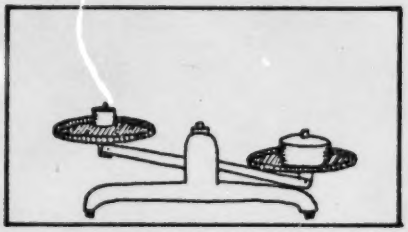


C

24. ¿Cúal balanza está equilibrada?



A



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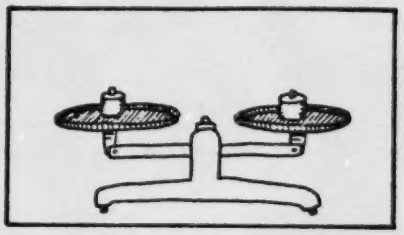
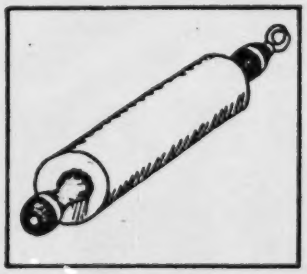


C

25. ¿Qué se usa para amasar?

A

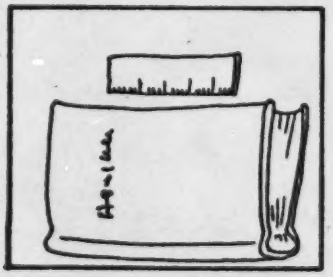
B



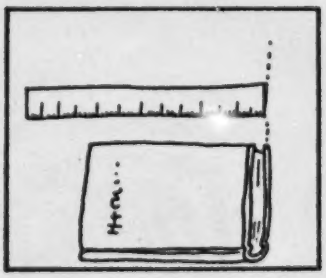
C

D

26. ¿Cuál dibujo te muestra cómo hacer una medida exacta?



A



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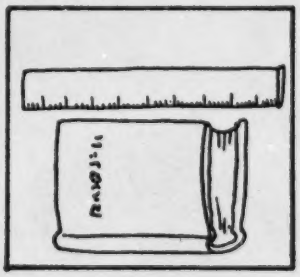

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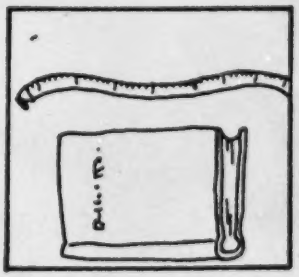


D

27.

Todos estos líquidos son _____?

A. ácidos
B. bases
C. neutros
D. venenosos

28.

A

B

C

D

¿CÚal de las actividades anteriores se puede hacer en aproximademente un minuto?
(Haz un círculo alrededor de la letra correcta.)

A.
B.
C.
D.

Sigue a la próxima página para continuar.

DIRECCIONES: Mira los tres dibujos en orden de la izquierda a la derecha. Escoje la palabra que mejor describe lo que está pasando. Pon un círculo alrededor de la letra al lado de tu respuesta.

29.

¿Cúal de estas palabras explica lo que le ocurre a la pelota?

A. se empapa
B. rebota
C. arregla
D. se aplana

30.

El último dibujo muestra _____ del trabajo de Jaime.

A. el diseño
B. el resultado
C. un rompecabezas chino
D. la constelación

31.

¿Cúal de estas palabras describe lo que está pasando?

A. hirviendo
B. expandiendo
C. disolviendo
D. concentrándo

32.

¿Que le occure al globo?

A. se expande
B. se condensa
C. está siendo medido
D. está siendo calculado

33.

El helado está _____.

A. hirviendo
B. derritiendo
C. pellizcando
D. expandiendo

Sigue a la próxima página para continuar.

DIRECCIONES: Usa los dibujos para contestár las preguntas. Pon un círculo alrededor de la letra al lado de tu respuesta.

34. ¿Cómo se llaman estos objetos?

A. experimento
B. medida
C. ingredientes
D. bióxido de carbono

35.

Se ven las/los _____ de los edificios en la calle.

A. sombras
B. hexágonos
C. rompecabezas chinos
D. perímetros

36. Jack y Maria están buscando un tesoro escondido. El papel que están estudiando probablemente es un/una _____.

A. mapa
B. tarjeta
C. gráfica
D. diccionario

37. ¿Qué pone la tetera en el aire?

A. ácido
B. cristal
C. humedad
D. negativos

38. En el dibujo Judy está mirando los pescaditos para ver si en algún momento se topan. Otra palabra para "mirar" es:

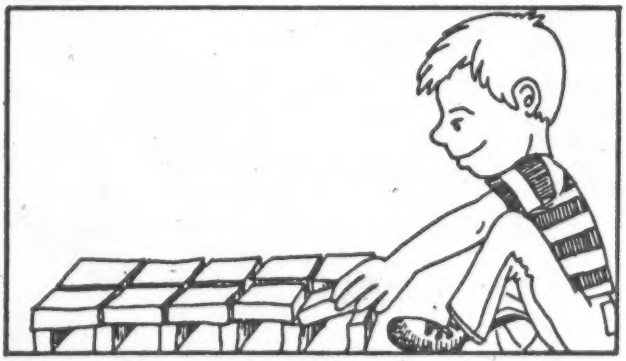
A. ocupar
B. registrar
C. reducir
D. observar

39. Jose quiere saber cómo es que un gusanito se tranforma en mariposa. Puso un gusanito en un jarro y lo va a mirar mientras cambia. ¿Cómo puede José aprender algo sobra el gusanito?

A. formándolo
B. observándolo
C. calculándolo
D. cristalizándolo

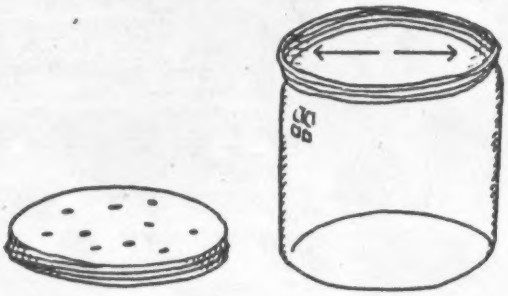
40. Antonio hizo un puente con bloques. Medía 10 bloques de largo y 2 bloques de ancho. Estas son _____ del puente.

A. la altura
B. la simetría
C. los materiales
D. las dimensiones



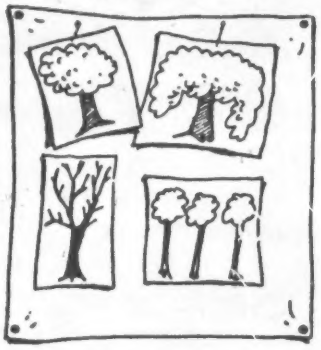
41. Barbara encontró un grillo bien grande. No está segura que la apertura de su jarro sea lo suficiente para que entre el grillo. Para averiguar si el grillo cabe en el jarro, Barbara tiene que medir el/la _____ del jarro.

A. altura
B. largo
C. diámetro
D. perímetro



42. Julia dibujó varios árboles. Decidió pegar todos sus dibujos en un cartelón grande. ¿Qué cosa estaba haciendo Julia?

A. un afiche
B. un diseño
C. un pentágono
D. un perímetro



43. ¿Qué hace Juan con la leche?

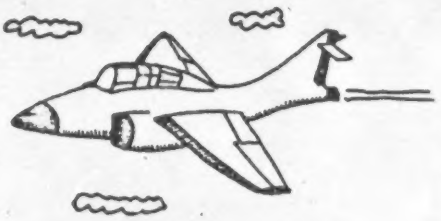
A. la vierte
B. la pronostica
C. la traza
D. la pela

44. Para hacer una sombra tienes que tener _____.

A. luz
B. zapatos
C. el sol
D. una cámara

45. El avión vuela en una cierta _____.

A. sombra
B. distancia
C. solución
D. dirección

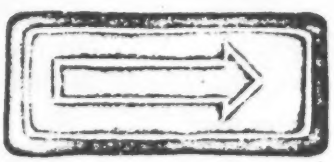


46. El Sr. Gálvez está tomándole una fotografía a su clase. Desgraciadamente, la cámara no funciona. ¿Qué le hará falta a la cámara del Sr. Gálvez?

A. película
B. cinta
C. cristales
D. negativos

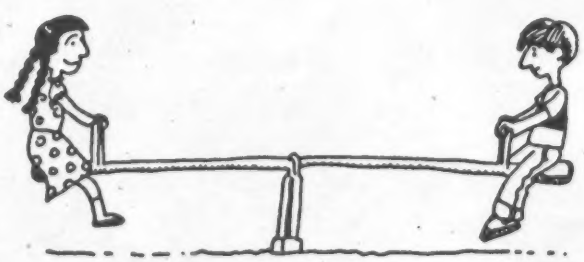
47. La flecha señala una cierta _____.

A. sombra
B. distancia
C. solución
D. dirección



48. ¿Cómo se llama la cosa que sostiene el columpio para que se equilibre?

A. circuito
B. apoyo
C. insolación
D. magnificación

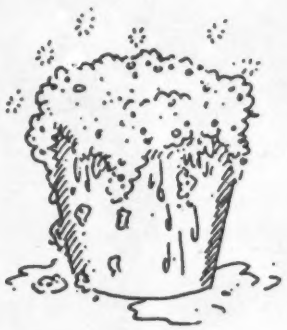


49. Cuando decimos que las "hojas crecen hacia arriba, y las raíces hacia abajo", estamos diciendo que cada cual crece en una cierta _____.

A. sombra
B. distancia
C. solución
D. dirección

50. Tomás se está sirviendo un refresco. Parece que echó mucho. Podríamos decir que se _____ el refresco.

A. flotó
B. reflejó
C. separó
D. derramó



51. A la abuelita de Jill se le estaba haciendo difícil leer el periódico. Dijo que las letras eran tan chicas que casi no las podía ver. Para que las letras se vean más grandes, la abuelita de Jill necesita anteojos que:

A. calcan
B. amplifican
C. reflejan
D. contráen

52. El jardín de verduras de Judy necesita agua. Llevó un extremo de la mangera al jardín y el pidió a su hermano que _____ el otro extremo al chorro.

53. José jugaba con un elástico de hule. Lo estiró y al tocarlo hizo un sonido. El sonido fue causado por _____.

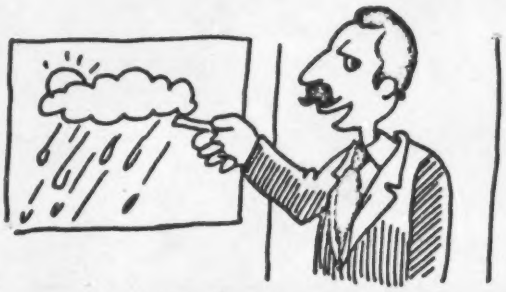
A. el grado
B. el equilibrio
C. el trago
D. la vibración

54. Susana y Sandra jugaban juntas. A la mamá de Susana se le ocurrió algo que podrían hacer Mezcló jabón y agua. Susana y Sandra usaron esta mezcla para hacer burbujas de jabón. Otra palabra para decir mezcla es:

A. sitio
B. solución
C. vibración
D. pronóstico

55. El reportero del tiempo dijo que mañana probablemente iba a llover. El hizo _____.

A. una cantidad
B. un pronóstico
C. una estructura
D. una comparación



56. La familia de José salió a caminar por el lago. José miró en el lago y se vió a él mismo. A veces los lagos son como los espejos. Los dos:

A. se quiebran
B. enfocan
C. se congelan
D. reflejan

Sigue a la próxima página para continuar.

DIRECCIONES: Lee cada historia. Contesta la pregunta. Pon un circulo alredan de la letra al lado de tu respuesta.

57. La plantita de Sharon se estaba muriendo. Ella no sabía por qué. Pensó que quizá era porque necesitaba más agua o más luz. Primero Sharon intentó darle agua más a menudo. Pasaron dos semanas y la plantita todavía estaba enferma. Entonces Sharon decidió que mejor ponía la plantita al lado de una ventana por donde entraba más sol. En una semana, la plantita se mejoró muchísimo. ¿Qué fue lo que hizo Sharon para averiguar lo que le pasaba a su plantita?

A. una gráfica
B. una receta
C. una medida
D. un experimento

58. La clase del Sr. Jacobo hacía ejercicios todos las tardes. Hoy le quería enseñar a todo el mundo un ejercicio nuevo. Para hacer este ejercicio, cada uno necesitaba un compañero/a. Amy y Beth decidieron trabajar juntas. Entre los dos formarían un/a _____.

A. circulares
B. pareja
C. identicos
D. mendigos

59. Juana y Susana decidieron ir en bicicleta a la farmacia. Se encontraron en casa de Susana y se pusieron a platicar acerca de sus bicicletas. A Juana le gustaba la bicicleta de Susana por su color rojo y por su bocina. La bicicleta de Juana era azul y no tenía bocina. Pero a Susana le gustaba la bicicleta de Juana porque tenía una canasta y un asiento suavecito. ¿Qué hacian las niñas al hablar de sus bicicletas?

A. calcarlas
B. compararlas
C. medirlas
D. diagramarlas

60. El Sr. Rodríguez tuvo que remendar el techo de su casa. Iba a tener que comprar una escalera para subirse al techo. Antes de ir a la tienda salío para ver qué alto tenía su casa. Aunque el Sr. Rodríguez no tenía una cinta para medir la altura, adivinó que quizá necesitaría una escalera de 20 pies do altura. ¿Cómo hizo el Sr. Rodríguez para llegar a esta conclusión?

A. anotó la altura
B. midió la altura
C. hizo una estimación de la altura
D. estiró la altura

61. La familia de Joselito tiene un perrito nuevo que se llama Tipi. Joselito quiere que Tipi se quede en la casa durante la noche para que no le de frío, pero el Papá de Joselito dijo que el perrito tenía que quedarse afuera todo el tiempo. Joselito decidió hacerle una casita a Tipi. Su Papá le dió madera y herramientas. Lo primero que tenía que hacer Joselito era ver de qué tamaño tenía que ser la casa para que cupiera Tipi. ¿Qué podría hacer Joselito para calcular el tamaño?

A. medir a Tipi
B. encojer a Tipi
C. construir la casa alrededor de Tipi
D. construir la casa con esperanzas de que sea lo suficientemente grande

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62. Después de clases, Jill fue a jugar a la casa de Cecilia. A la hora de que se tenía que ir Jill a su casa, se preocupó la mamá de Cecilia, pensando que quizá iba a llover. Decidió que lo mejor sería prestarle el impermeable de Cecilia a Jill para que no se mojara en el camino. ¿Cómo supo la mamá de Cecilia que las niñas eran de casi el mismo porte?

A. lo trazó
B. lo anotó
C. lo calculó
D. lo magnetizó

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63. Tomás y Alfredo estaban haciendo pudín de chocolate. En la caja las indicaciones les explicaban cuánta leche usar. Tomás echó el polvo del pudín en un plato hondo. ¿Qué debería hacer Alfredo antes de echarle la leche al pudín?

A. calentarla
B. tomársela
C. pesarla
D. medirla

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64. Ana necesitaba una linterna para poder ver si su gato estaba debajo de la casa. Cuando encendió la linterna, vió que no funcionaba. Pero Ana no estaba segura de lo que le pasaba a su linterna. Tal vez necesitaba un nuevo foco, o quizá baterias nuevas. Para averiguar, Ana primero le puso baterias nuevas primero. La linterna no funcionó, así es que Ana pensó que lo que necesitaba era un nuevo foco. ¿Qué hizo Ana para averiguar que le pasaba as su linterna?

A. una gráfica
B. una receta
C. una medida
D. un experimento

FIN DE LA SECCION II